Composition, Improvisation and Meta-Composition

Curtis Robert Bahn

A DISSERTATION

PRESENTED TO THE FACULTY

OF PRINCETON UNIVERSITY

IN CANDIDACY FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

RECOMMENDED FOR ACCEPTANCE

BY THE DEPARTMENT OF MUSIC

January 1998

This essay, together with the compositions included in score and on CD I, constitute the dissertation but are otherwise unrelated except where referenced within the essay.

Principal Readers for this essay were Professor Paul Lansky and Professor Paul Koonce.

Abstract

This essay explores concepts and practices involved in the creation of non-linear, interactive musical compositions. Established compositional and improvisational paradigms are examined leading to the development and definition of *meta-composition:* a composition that itself composes or facilitates composition.

Chapter one introduces general concepts of musical organization, and presents a definition of meta-composition. Harold Cohen is introduced as the first *meta-artist..*

Chapter two examines historical precedents for non-linear musical composition and meta-composition. Composers and genres covered include: Mozart, Earle Brown, Christian Wolf, Electro-Acoustic Music, Live-Electronic musical performance, CD-ROM authoring, Jazz improvisation, Pauline Oliveros, John Zorn, and D.J. culture.

Chapters three through seven examine numerous examples of the author's work illustrating involvements in improvisation, algorithmic composition and meta-composition. Three individual chapters are dedicated to the development of performances scores as hyper-media documents. These chapters include the works, *Transitions* for improvisational trio, *Prelude* for solo string-bass and electronics, and the author's interface for group improvisation and performance

Chapter eight views of the future of meta-composition as a common-place musical involvement which reintegrates computer music composition and performance into the social context of music-making.

Acknowledgments

During my time as a graduate student at Princeton I was fortunate to perform with many fine musicians from the University, and the surrounding area. Many of these musicians are represented in this essay and I would like to thank in particular Jeff Presslaff, Cedrik Jensen, Bob Ward, Satoshi Takeishi, and Dan Trueman for all of their help, and for many hours of wonderful music.

Ron Quaglia, whose performance is documented in chapter five, unexpectedly passed away as I was completing my dissertation. I dedicate this work to his memory, the memory of my parents and my mother-in-law.

I thank my wife, Tomie Hahn for her unwavering support. Sharing a single room which acted as both my music studio and her office while we were writing our dissertations took great patience and understanding.

Thanks to Charles Dodge for all his help and encouragement.

I would like express my gratitude to Paul Lansky, Steve Mackey, Paul Koonce and the Music Department of Princeton University for the most meaningful educational experience of my life. Without their support and encouragement I never would have been able to bring the various threads of my musical background together in this essay, my current work and my life.

Dedicated to the Memories of

Robert C. And Miriam R. Bahn

Maude Miyako Hahn

Ron Quaglia

Composition, Improvisation and Meta-composition

Table of Contents

Index of Composition and Sound Example CDs

CD I, Compositions

Index 1: *Meditation* (1992)
Tomie Hahn, Shakuhachi
Recorded at Princeton University Taplan Auditorium (3/1/94).
Jim Moses, Engineer

Index 2: *Farewell* (12/18/93)

Index 3: *Transitions*
Live performance, Princeton University Taplan Auditorium (12/5/95).
Ron Quaglia, Guitar
Cedric Jensen, Drums
Curtis Bahn, Bass

Index 4: *Prelude*
Live performance, Princeton University Taplan Auditorium (5/14/96).
Curtis Bahn, String-Bass

Index 5: *Zeltzimba*
Recorded at Princeton University Taplan Auditorium (10/30/96).
Jim Moses, Engineer

CD II, Sound Examples for "Composition, Improvisation and Meta-Composition"

Chapter 3, A Trip on *My Ship*

Index 1: *My Ship* (8/14/95), excerpt
Index 2: *My Ship* (8/14/95), excerpt
Index 3: *My Ship* (8/21/95), excerpt
Index 4: *My Ship* (12/28/95), excerpt
Index 5: *My Ship* (1/23/96), excerpt
Index 6: *My Ship* (8/23/9), excerpt
Index 7: *My Ship* (8/23/95), excerpt
Index 8: *My Ship* (9/11/95, excerpt
Index 9: *My Ship* (8/2/95), excerpt
Index 10: *My Ship* (8/25/95), excerpt

Chapter 4, Algorithmic Mixing Pieces (1993-1995)

Index 11: *Farewell* (12/18/93), excerpt
Index 12: *Farewell* mix 3 (11/30/93), opening
Index 13: *Farewell* mix 7 (12/2/93), opening

Chapter 6, *Prelude*

Chapter 7, Quartet Improvisations

other artist's interpretations, and performed it herself in many different contexts. She has spent years developing her own interpretation and refining her bowings, dynamics, articulations, fingering, tempi etc. Tonight, in performance, she decides to play the Courante slightly faster than she normally does.

2) A famous conductor leads a large symphony orchestra in the debut performance of a contemporary work. It is a very difficult and lengthy composition involving non-standard instrumental techniques. The string scores are notated on several staves: one stave of traditional notation augmented with symbols for pitches beyond the usual 12, two other graphic staves depict bow placement, articulation, speed and pressure. All of the instrumental parts are specified with a similar level of performance detail. Due to the difficulty and cost of rehearsing such a large ensemble, the group only has had a limited period of time to learn the new notations and to rehearse the piece. They rely heavily on the conductor for cues and reference points in a stream of shifting meters. Without his direction the ensemble would never stay together. He conducts from a large score, a computer click-track aids him in beating the metric changes and tempi exactly as specified.

3) A jazz bass player is called to play an evening at a New York City club. He has never played with the group before. The regular bass player filled him in on the group's concept by saying that they are fairly traditional but like to "stretch." He meets the group

Play or get off!

Chapter One

Forms and Meta-forms

Consider the following contexts of musical performance:

1) A 'cellist plays the first solo suite of J.S. Bach in a small recital hall. She plays from memory, having studied and practiced the piece from the written score for years. She is faithful to the score, and to what she knows of the performance practice of the historical period. She has always loved this suite, first hearing it performed when she was just a small child. Since then she has attended numerous performances, collected recordings of

on the "stand" (being careful not to tip off the audience by shaking anyone's hand). He has little or no music in front of him, but he knows most of the standard tunes. A few original compositions have been notated for him in a shorthand, providing the overall arrangement, the repetitive harmonic form for the improvisatory sections, and the main melody. The sax player starts the set by playing a freely improvised solo. At a certain point it seems that he is referencing melodic and harmonic structures from the standard tune "Stella by Starlight." The rest of group joins in, supporting the basic key centers of the tune, and timbrally coloring the solo with rolls and pedal tones. After a cadence point the sax player plays the first two notes of the tune in tempo. The band responds with the usual unison rhythmic "hits." Over the course of the night the bass player loosens up to the group, interacting rhythmically with the drummer, harmonically with the piano player and sax player, and working with the ensemble to shape the contours of the music. Afterwards, an audience member who regularly listens to the group comes up and says he enjoyed hearing the musical effect that the new member had on the ensemble.

4) You buy a CD of your favorite computer music composer. At a recent concert you heard one of the compositions from the disk played over high-quality loud speakers in a medium size recital hall; the sounds of the piece were beautiful, clear and full. The composition involved the processing of natural sounds, the computer was used like a sonic microscope revealing the intricacy of the sound's inner structure. The composer mixed in

synthetic textures drawn from a computer-analysis of natural sounds. The piece doesn't sound quite as good on your home stereo system, but it is still enjoyable. You play it at a medium volume one morning while you drink a cup of coffee.

5) You purchase a CD-ROM of a new interactive adventure game. In the tradition of *Myst*, the program reveals a rich multi-media environment which you explore freely. Sound is used in several ways by the game. Every "place" that the game takes you has a unique set of ambient sounds and/or music. These sounds run constantly while you play, they are very pleasant and give you a strong feeling of location while you ponder the mysteries of the environment. When you re-enter the same location, the sounds are subtly different, giving a natural feeling to the exploration of virtual space. Other sounds seem to be linked to specific features within the environment such as other living things, machines, or aspects of the landscape. As you navigate the space, these sounds give you aural cues as to the features' movement or location relative to you. Another set of sounds seems to react to your specific actions and could range from "sound-effects," to a sound or text which is played only if you make an appropriate action. The environment is beautiful, even addictive. The sounds are so integral to the space that you would not be able to play the game without them. Sometimes, long after you had found all the clues, you enter the space called the "Water-Cavern," and stay there for long periods of time, playing the sounds over your stereo system.

Discussion

These examples highlight contexts for musical performance within a spectrum of current practice. Each represents a point in a complex space of pre-determined and indeterminate musical elements, tradition and innovation, personal choice and external control, group coordination and interaction. Defining this space is musical culture, technology and the various media of transmission; oral/aural transmission, musical notation, instrumental performance, computer sound synthesis, sound recording, musical tradition, performance practice and musical memory.

The first example is drawn squarely from the classical tradition of instrumental performance. The Suites represent a balance between notated compositional specifics by Bach, the oral/aural tradition of performance practice, pre-determined interpretations by an instrumentalist, and spontaneous expression in performance. Familiarity with the form allows the performer and audience to focus on microscopic details and deviations which create a specific interpretation and performance. The composer's structure creates a vehicle of personal expression and communication between the performer and the audience. Recording and broadcast technologies have enhanced this tradition by creating new means of musical dissemination and documentation; we can still hear Casal's interpretation and compare it to Yo Yo Ma's; Yo Yo's recording may be a studio construction based on numerous 'takes' assembled in a computer to create an idealized virtual performance.

The example of the fictitious contemporary orchestral composition extends the

tradition of notated music. Here we see the primary vehicle of transmission as the written score. Being a new composition there is no body of prior interpretations; the piece draws upon contemporary performance practice but also adds innovative new techniques. The level of specification for both the conductor and the performers leaves little room for personal interpretation. As professional performers, they take pride and satisfaction in participating in the realization and communication of the artistic conception of the composer. In both of the first two examples, it is clear that the composer/ performer/ listener musical paradigm is operative. There is a marked difference however, in the degree to which the performer is involved in the interpretation of the work.

In the example of the jazz bass player we see the modern practice of an oral/aural tradition. While it is possible that the player may not see a note of written music all night, he is able to interact in a complex and organized way with a group of musicians he has never met before. Especially on first meeting, the established performance practice of the genre determines to a great extent the ways in which the players will interact over the course of the evening. A body of common practice compositions, "standards," provides the repertoire, and a mass of recorded performances of these forms creates a documented base of interpretative approaches. There is a good possibility that the audience is also familiar with these forms and can appreciate any references to, or deviations from common practice.

In the case of jazz, the spontaneous interaction and communication between musical

participants can be at least as important as the communication of the ensemble to the audience. Here, the composer/performer/listener paradigm is not necessarily the primary musical model. In many cases the compositions were not ever intended to be performed in this way, they were appropriated from popular culture to provide a point of departure for improvisation. In cases where a compositional structure was conceived of as an improvisational vehicle, the genius of the composer may have been in his ability to stay out of the performer's way; to provide a form which creates a unique musical context without restricting expression.

A major mode of communication in this paradigm is performer/ performer or participant/participant. Communication can range from being direct, gestural and personal, to cerebral and abstract; referencing theoretical constructs of the language of jazz, or of other forms. This example presents a model of music as open, spontaneous and interactive. The listener also can become a participant in the music event through clapping, movement and vocal interjections after solos or at exciting moments. His appreciation of the music rests on his empathy with the musical context as much or more than its "purely musical" content. As expressed in a recent radio interview with jazz pianist/composer Chick Corea, the listener needs to connect with the "spirit of adventure" in jazz performance.

The example of the computer music composer presents an extreme case of technological influence on musical transmission. Freed from the constraints of physical

instruments and the need to coordinate human performers, he can sculpt sound directly as a visual artist sculpts clay. The result is a fixed musical form disseminated by recording or broadcast media. In a way that no human performance activity can match, the composition truly becomes an object, immutable and static. The control and individual action of composition in this genre creates a uniquely personal form. The only effect that we may have on the work is in the context, loudness, and the hardware on which we appreciate it - the frame and where we hang it. The musical paradigm becomes purely composer/listener.

The CD-ROM presents a new and unique case of musical form, interaction and dissemination. Sound and other media is manipulated with the control and precision offered the traditional composer of computer music discussed above. However, these materials are put into a dynamic interface which allows the listener to freely traverse them as a multi-media environment. The "listener" becomes active in selecting and forming the music within the constraints of the environment. The constraints may be extensively composed, adding to the listener's engagement in learning to traverse the space. Still, the music (if one were to evaluate it purely as such) would be the result of a collaborative process between composer and listener.

Listening to the resulting sounds from an interactive environment on CD-ROM, one may recognize them as "locations" within the game, however, since they have no set form or structure it is difficult to use traditional methods to evaluate them as parts of a musical composition. As dynamic multi-media structures such as this become increasingly

common and sophisticated, we must seriously examine the musical implications presented by this new form of musical structuring and dissemination.

With the exception of the CD-ROM, each of the examples presented here includes a clear pre-definition of the musical structure that is being performed. In the case of the computer music CD, the structure is fixed and static in a digital storage medium. Proceeding along a continuum, the other musics are to varying degrees held in notation, recordings and oral/aural history and performance practice. Along with the notion that there is "a piece" which is being performed comes the corollary, that there is be the possibility that a performance does not achieve the goal of fully realizing the piece. In other words, the music exists within boundaries of interpretation and performance outside of which it would cease to be recognized. The boundaries may be subject to interpretation and discussion, and may change through consensus over time. These musical forms are defined and recognized through their time-based structures. Even in the case of jazz, where the exact performance structure is unknown, there is in most cases a rigid adherence to the repetitive form and meter of the tune. For the most part, if the elements of these musics were performed in a different sequence, or were played out of tempo and synchronization, they would lose their identity.

It is clear that outside of the first two examples the composer/ performer/ listener triangle begins to lose its relevance. In tape music, the idea of the performer and his musical interpretation is diminished; in jazz and improvisation, the role of the composer,

and possibly even the listener, is lessened. In the example of the CD-ROM, the roles of performer and listener are fused. In fact, the composer/ performer/ listener paradigm is only operative within a very narrow range of musical activity.

The notion of the performance of a musical composition is a fragile and elusive concept. It is related to the desire to produce a recognizable and repeatable musical identity. The ability to do this could involve the need to coordinate large numbers of human performers, or create elaborate musical machines for sound representation and reproduction. The organizational structures of some musics may be held in human memory and transmitted orally. More highly defined and unique structures may need to rely on some form of media as an additional memory aid, or for the direct specification, coordination and control of musical performance.

Today, the conceptual space of musical performance is vast. It embraces traditions from all times and cultures, and is fueled by an ever advancing parade of technological development. Technological changes have affected every aspect of musical transmission. Discreet models of musical participation, such as the composer/performer/ listener triangle, do not serve to describe current practice and may only narrow the view of music in contemporary world culture. With the common-place mechanical reproduction of music, the need to focus on the repeatability of a composition becomes diminished. Fixed media, such as the technology of print, is giving way to dynamic media, such as hyper-text and hyper-media. Along with this shift come a basic change in the relationship of humans to

technology, and the structuring of information.

In music, interactive, non-linear and non-temporally based structuring of information leads to problems relating to our traditional definitions of musical activities. Given the increasingly common dissemination of music of this sort we must face these issues. How then do we evaluate musical contexts which do not stress recognizable, repeatable, time-based, defined interaction? Rather than regarding them as "composition", we may consider them as "meta-composition."

Meta-art

The concept of "Meta-art" was perhaps first presented in writings concerning the work of visual artist Harold Cohen. Starting with his introduction to computers while a visiting professor of art at the University of California at San Diego in 1968, Cohen has been involved in the creation of a computer algorithm which makes drawings autonomously. His program, Aaron, draws upon concepts from the field of artificial intelligence, and embodies general rules that Cohen developed through his experience as a visual artist. In creating Aaron, Cohen has said, "I believe that my behavior in programming the machine to simulate art-making behavior is, in itself, primarily art-making behavior."[1] This reflexive involvement, the artist building a model of art-making, became the basis for Herbert Simon to write the following in a catalog for an exhibit at the Buhl

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1 From Pamela McCorduck, *Aaron's Code, Meta-art, Artificial Intelligence, and the Work of Harold Cohen* (New York: W.H. Freeman and Company, 1991), 46.

Science Center in Pittsburgh, Pennsylvania in 1984:

> To understand and appreciate these drawings, we must understand the respective roles of the computer and Harold Cohen. Clearly the computer is the artist, it does the drawing, its activities guided and determined by the program that lies in its memory (just as human artists' knowledge and skills lie in their memories). Harold Cohen, equally clearly, is the meta-artist, the teacher.[2]

In the book "Aaron's Code," Pamela McCorduck develops the term and uses it consistently as: "Meta-art; creating the functional equivalent of the artist,"[3] or, "a piece of art that itself makes art."[4] For McCorduck, the use of the computer is implicit in the definition of meta-art and the work of Cohen:

> It's the computer that makes Cohen's part unprecedented in that self-referential dialogue on the nature of art: for the first time ever, the *act* of making art is represented by a computer program that autonomously makes drawings, relying on its own rules and its own feedback paths to make decisions about each of the thousands of drawings it has made. Without the computer there could have been no workable representation of such a process.
>
> So Aaron is the first of its kind, the representation of the artistic *process* as distinct from an artistic *object*: Aaron as program is process, rule-based and at the same time disconcertingly aleatory; the entity called Aaron makes art objects. Here's the condition that vaults Aaron's creator, Harold Cohen, onto the plane of the meta-artist. Cohen is first to occupy that plane, and for now is there alone.[5]

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2 Ibid., 46.

3 Ibid., 35.

4 Ibid., 46.

5 Ibid., 195.

Meta-mediums

In the book "Digital Mantras," Stephen Holtzman attempts to establish an aesthetic foundation for the use of computers for creative expression. He states that the use of computers in the creative process "mandates that we think of communicative and creative processes in terms of abstract structures and the manipulators of such structures." He views the computer as the "ultimate manipulator of abstract structure:"[6]

> Within the computer itself, in fact, there are only abstract structures. Ultimately the computer must realize its "constructions" in some medium to enable us to interpret the abstract structures it has created. Computers construct abstract representations - abstract structures - that can, with appropriate rules, be mapped onto any number of different media.[7]

He further describes the unique qualities of these representations:

> The representations maintained within the computer in some abstract form can, in a sense, be thought of as a *metamedium*. The representation within the computer is not the medium for its realization. It is an abstracted form - a metarepresentation - of the structures that will be realized in some other medium. Even virtual realities, which are never realized in a tangible medium and which only exist within a computer, must be mapped from the computer's abstract representation to a form experienced through the senses for human interpretation.[8]

Holztman examines different approaches to using the computer in the creative process, noting that while the computer is a tool, it has the potential to take on a role that

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6 Stephen Holtzman, *Digital Mantras* (Cambridge: The MIT Press, 1996), vii.

7 Ibid., 215.

8 Ibid., 216.

conventional tools cannot. Traditional tools, such as a paint brush, do not function without a human guiding force, but:

> Unlike such traditional tools, computers used in automated creative processes have an independent role. Used as a *decision-making* tool, the computer is an extension of the mind, a tool to manipulate abstract objects and structures, rather than of the hand or the eye.[9]

These tools need not be entirely autonomous thinking machines, instead they can be conceptualized as "intelligence amplifiers," Holtzman quotes computer scientist Frederick Brooks:

> I believe the use of computer systems for intelligence amplification is much more powerful today, and will be at any point in the future, than the use of computers for artificial intelligence (AI). In the AI community, the objective is to replace the human mind by the machine and its program and its data base. In the IA community, the objective is to build systems that amplify the human mind by providing it with computer-based axillaries that do the things that the mind has trouble doing.[10]

Meta-composition

A "meta-composition" is a composition that itself composes, or facilitates composition/performance. It can be a construct of media, oral/aural transmission, and/or electronic technology. The meta-composition informs conventional musical activities, such as composition, improvisation or performance, yet itself does not prescribe a specific time-based musical entity. It can range from a set of rules for improvisation, to an extensive

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9 Ibid., 218.

10 Ibid., 218.

interactive multi-media computer interface which dynamically coordinates musical information in many forms. As with composition, meta-composition is both an abstraction of a musical idea and an activity; a noun and a verb.

Two basic criteria for meta-composition which should serve to differentiate it from other musical structures are:

1) The interpretation of a meta-composition creates musical structures which will differ in some ways in each instantiation, as a result of dynamic processes.

2) As opposed to meta-art, the realization of a meta-composition may be carried out by humans and/or technology.

Meta-art, as described by Simon, McCorduck and Holztman, has dealt mainly with the model of the "meta-artist/ teacher," programming the "artist/ computer," in order to create an identifiable "art-object or composition." The concept of meta-art as applied to performance and interactive genres must be extended to include the collaboration between the meta-form and the participants, and the use of the meta-form in the structuring of new environments for human interaction. In this way the importance of the computer as an autonomous artist in realizing meta-composition is diminished. Meta-compositional structures can be realized by computers, humans or a combination of both. In this way, the concept of IA, "building computer-based axillaries that do things that the mind has trouble doing," becomes particularly interesting when applied to meta-compositional designs for interactive performance, as does the use of human performers and improvisors as

autonomous collaborators.

Conceiving of an abstract structure in one medium which must be realized in another is certainly not foreign to traditional views of musical composition: routinely a composer prepares a symbolic representation of a musical work which is realized by instrumental performers. In this way, the composer/performer relationship has many qualities similar to those described by the "meta-artist/artist." There are numerous historical instances in music of compositions which describe a musical entity as an abstract process which creates new structure in every instantiation. These include "musical games," indeterminate graphical scores, structured improvisations, computer-aided composition, and interactive media. Improvisational genres such as jazz encompass countless forms which take on drastically different characteristics in every performance. The traditions of these musics teach us a great deal about the nature of human interaction in artistic contexts. As we now see the rush towards interactive media of all sorts, the experience of these traditions is invaluable in conceptualizing new interactive musical paradigms.

Before the use of electronic media and the computer, interactive performance structures were limited by human memory and the medium of print. By using the computer we can construct interfaces that extend our capacity to conceive of dynamic musical structures and processes, and to organize ourselves within them. These interfaces can co-ordinate dynamic computer algorithms which include both deterministic and aleatoric compositional procedures, musical notation, performance directions, stored sounds, and

signal processing routines. The preparation of these structures is meta-composition, their use can be in contexts such as composition, performance, improvisation, and installation.

Chapter Two

History and Conceptual Background

Several threads of musical thought merge in the idea of meta-composition. These include: acoustic music which is indeterminate with respect to performance, electro-acoustic compositions on tape, live-electronics, computer-aided composition, interactive computer systems, improvisation, and "D.J." mixes. This chapter will provide a brief overview of issues and figures central to the development of the representation of music as process.

Repeatability: The Basis for the Compositional Paradigm

In "The Musical Experience of Composer, Performer, Listener," Roger Sessions

states that:

> In fact, composer, performer, and listener can, without undue exaggeration, be regarded not only as three types or degrees of relationship to music, but also as three successive stages of specialization. In the beginning, no doubt, the three were one.[11]

He views the emergence of the composer as happening "at the moment that a bit of musical material took on a form that its producer felt compelled to repeat."[12] The performer's role became clear as "the first musician who played or sang something that had been sung before."[13] Listening to music as distinct from reproducing it is described as "a relatively late, a relatively sophisticated, and even a rather artificial means of access to it..."[14] Even though the three are viewed as separate, specialized activities, Sessions reiterates:

> I have tried to show as clearly as possible that composer, performer, and listener each fulfill one of three separate functions in a total creative process, which was originally undifferentiated and which is still essentially indivisible... The essential is that music is an activity: it is something done, an experience lived through, with varying intensity, by composer, performer and listener.[15]

We see in the emergence of this paradigm the separation of the roles of composer,

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11 Roger Sessions, *The Musical Experience of Composer, Performer, Listener* (Princeton: Princeton University Press, 1950), 4.

12 Ibid., 5.

13 Ibid.

14 Ibid., 4.

15 Ibid., 9.

performer and listener stemming from the desire to make a musical experience repeatable. In this way the technologies of notation, publication and distribution have defined and created the "artificial" (according to Sessions) schizm in musical participation and appreciation that has developed in our society. In the days when the primary mode of musical dissemination was through the publication of sheet music, many people were trained as amateur performers, encouraging them to participate directly in the re-creation of musical compositions. This involvement was thought to increase their appreciation of the genius of great composers and virtuosi:

> Even well into the nineteenth century, the musical public consisted largely of people whose primary contact with music was through playing or singing in the privacy of their own homes. For them concerts were in a certain sense occasional rituals which they attempted as adepts, and they were better equipped as listeners because of their experience in participating, however humbly and however inadequately, in the actual process of musical production.[16]

After the development of recording and broadcast media, the focus of "musical appreciation" became the development of a musical public of informed consumers. Recordings enabled musical performances to be easily repeated. Radio and television extended the musical public from the concert hall to a "mass audience," tuning in world-wide. Understanding of new musical works became viewed more as a result of their repetition, as opposed to the empathy of the audience to the musical performance process. As Sessions states:

> Once more, the key to the "understanding" of contemporary music lies in repeated

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16 Ibid., 7.

> hearing: one must hear it till the sounds are familiar, until one begins to notice false notes if they are played.[17]

The ability to have this kind of intensive repeated performance is greatly enhanced by recording media. As Aaron Copland states:

> The key to the understanding of new music is repeated hearings. Fortunately for us, the prevalence of the long-play disk makes this entirely possible. Many listeners have attested to the fact that incomprehensibility gradually gives way before the familiarity that only repeated hearings can give.[18]

The introduction of recording technology has greatly altered the experience of composer/ performer and listener. The paradigm often now becomes that of composer/ performer/ recording/ listener. The issue of repeatability, the basis for the triangle, becomes essentially moot. The sound recording has a unique quality: it seems that one can become accustomed to, even accept as musical, most anything that one is exposed to on the fixed medium of tape. Consider an analog recording: the sounds of static, clicks and pops set on tape become, over repeated listenings, an integral aspect of our experience of the music.

Recording technology, in a sense, allows anyone to be a performer in that he can "play" any music at any time. By developing unique compilations and mixes, he also becomes the composer of new forms. Even in this rudimentary use of technology, we see

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17 Ibid., 98.

18 Aaron Copland, *What to listen for in Music* (New York: Mc Graw-Hill, 1957), 151.

interaction with electronic media as an essential force in healing the "schizm" of composer/ performer/ listener and creating a musical culture which is again based primarily on musical participation.

Along with interest in interactive/ participatory musical forms comes a focus on creating musical structures which are different in every performance. These differences can range from traditional "interpretive" parameters, such as tempo, rubato, vibrato etc., to meta-compositions which have unique content and form in every instantiation.

The interest in meta-composition is not new, following are descriptions of numerous examples relating to the development of meta-compositional musical structures.

Mozart's *Musikalisches Wurfelspiel*

An historical example of a meta-compositional musical game is the *Musikalisches Wurfelspiel*, (Musical Dice Game) by W.A. Mozart, published posthumously in 1793 by J.J.Humel. For this work, Mozart composed multiple musical possibilities for each of the sixteen bars of a Minuet. For the 8th and the 16th bars he made two possibilities, for all other bars - eleven. Each of the fragments was constructed so that any possible succession would create an acceptable minuet, fulfilling the harmonic and compositional requirements of Viennese minuets of that time. To realize a version of the minuet, one tosses two six-sided dice, summing the result. The result is located on a table of possibilities, a different set for each bar of the minuet. This process generates a huge number of possible

"variations" of the minuet (approx. 1.5 * 10 ^15).[19]

This compositional concept had previously been tried by P. E. Bach and J. Haydn, but Mozart's piece is now by far the best known example. [20] In recent years several world-wide-web sites have developed which are devoted to real-time implementations of the *Musikalisches Wurfelspiel*. [21] These sites provide interactive interfaces which give information about the history and concept of the composition, allowing visitors to hear spontaneously generated minuets via MIDI.

Contemporary Examples

Since the 1950s, many composers have investigated the possibilities of indeterminate music formed as a result of dynamic processes. Three main approaches are: spontaneous ordering and combining of pre-composed musical materials in performance, the incorporation of live-electronic designs and organizational schemes available through media technology, and structured improvisation. The following discussion presents only a few key figures relevant to the history and development of meta-composition.

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19 Zsofia Ruttkay, "Composing Mozart Variations with Dice," unpublished paper, (Amsterdam, Netherlands: Vierkant Foundation, Vrije University, 1996).

20 H. Gerigk, "Wurfelmusik," (Zeitschrift fur Musikalische Wistenschaften, XVI S.), 359.

21 J. Chuang, "Mozart's *Musikalisches Wurfelspiel*," http://204.96.11.210/jchuang/Music/Mozart/mozart.cgi, and, Zs. M. Ruttkay and B. Boskamp, "Composing Mozart Variations with Dice." http://www.cs.vu.nl/~zsofi/mozart.

Earle Brown

Earle Brown has produced numerous works employing innovative notational designs. In his compositions from the early 1950s he pioneered graphic notation, "time notation" (which has come to be called proportional notation), and an approach to dynamic structuring of composed musical materials which he called "mobile form" or "open form." His interest focused on graphic systems in which new notations played a "really functional" role in the essential nature of the musical conception of the work:

> By "really functional role," I mean that the piece could *not* have been notated traditionally and that the sound of the work is of an essentially different character because of the new notation. The "decorative" value of a score is in itself a pleasure but I am more concerned with the possibilities of a notational system which will produce an aural world which defies traditional notation and analysis and creates a "reality" which has not existed before.[22]

As a result of his experiences as a jazz trumpet player and his interest in the approach of contemporary visual artists, he experimented with systems which attached importance to "spontaneity, direct spontaneous action, and more spontaneity in the compositional process."[23] His works allow performers direct engagement in the creative process of structuring musical form in performance. He discussed this "non-method" of conceiving form as:

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22 Earle Brown, "The Notation and Performance of New Music" (*Musical Quarterly* 72/2, 1986), 181.

23 Earle Brown, "Panel Discussion: Notational Problems" (*Proceedings of the American Society of University Professors* 5, 1970), 8.

> A function of people acting directly in response to a described environment, accepting the fact that there is no formless thing or event and wishing for the coexistence of rationality and irrationality in the unfolding of *Form* as a dynamic process.[24]

He viewed a work and any one performance of it as "a process, rather than static and conclusive:" [25]

> For me the mobility (or mutability) had to be expressed during the *performance* of the work (as in a mobil of Calder), and expressed spontaneously and directly by the performer, as in the immediacy of contact between Pollack and his canvas and materials. These two elements - mobility of sound elements within the work, and the graphic provocation of an intense collaboration through-out the composer-notation-performer process - were for me the most fascinating new possibilities for "sound objects" ... The necessity for a new means of graphic representation is obvious.[26]

The fundamental motivation in the creation of these works was the production of a " 'multi-ordinal' communication activity between the composer, the work, and the performer, and a similarly 'open' potential of experience for the listener." He felt that this view of structuring music necessitated a redefinition of the concept of a musical "work" as being the "activity of producing as well as the acquisition of a final result (the influence of Calder)".[27]

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24 Earle Brown, "Form in New Music" (*Source* 1/1, 1967), 48.

25 Earle Brown, prefatory note from *Folio* (Associated Music Publishers, 1961).

26 Earle Brown, "Panel Discussion: Notational Problems" (*Proceedings of the American Society of University Professors* 5, 1970), 192.

27 Earle Brown, "The Notation and Performance of New Music" (*Musical Quarterly* 72/2, 1986), 199.

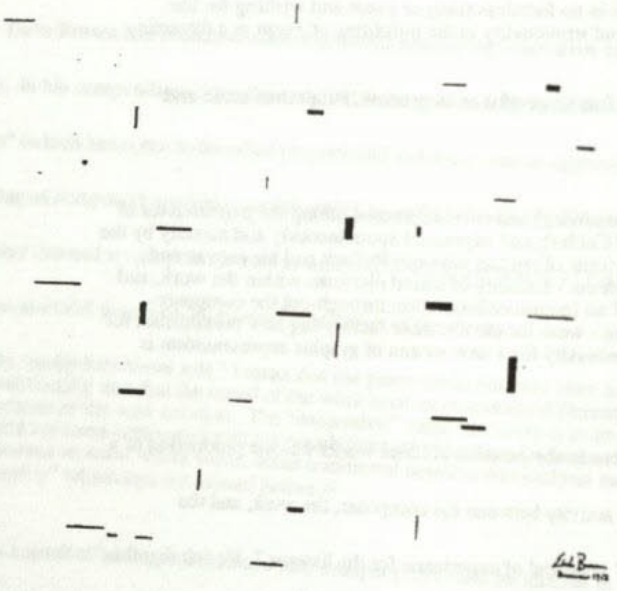

Figure 2.1 Earle Brown, *December 1952*

Throughout most of Brown's work, the "compositional identities" of his pieces are strongly maintained. Even when dealing with open form he maintained a role of generating and representing all musical material. Although in his performance directions from *Folio* Brown refers to the work, *December 1952*, as a "composition," the lack of compositional specification in terms of content and form presents an issue relevant to the consideration of meta-composition. The score (figure 2.1), written for "one or more instruments and/or

sound-producing media," may be performed from any point in the defined space, for any duration, and may be performed from any rotation, in any sequence. Each performer is to play from his or her own score, usually with no preliminary definition of the events beyond the performance duration. Brown writes later:

> *December 1952* raises a question whether a work whose form and content are different in each performance can be called "open form." My personal answer is no; in order to be called an "open form," a work must have an identifiable content which then can be formed as in *Twenty Five Pages* or the *Available Forms* works. By this definition, *December 1952* is not a piece of music at all; it is musical activity when performed. This creates further confusion because the moment it is performed, *December 1952*, is as much a musical work as any ever heard. It is only one's attachment to the academic concept of literature, an art object, that is violated. The form which the work takes is *a* form of collective consciousness as it moves through a labyrinth of environmental influences. A performance is composed rather than a composition is performed. I prefer to think of form as the result of activity in relation to a labyrinth of implications rather than as a fixed configuration.[28]

Christian Wolff

Christian Wolff's early music shows the influence of his close relationships with Cage, Feldman and Brown in New York. About this period he states:

> The earlier work is more concerned with indeterminacy. What I was particularly interested in, more than either Cage or Feldman were, was the question of how performers relate to each other, not necessarily in the psychological or social sense, but more in the sound that resulted when people had to co-ordinate with each other in certain unpredictable ways.[29]

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28 Earle Brown, "Form in New Music" (*Source* 1/1, 1967), 50.

29 Geoff Smith and Nicola Walker Smith, *New Voices - American Composers Talk About Their Music* (Portland Oregon: Amadeus Press., 1995), 215.

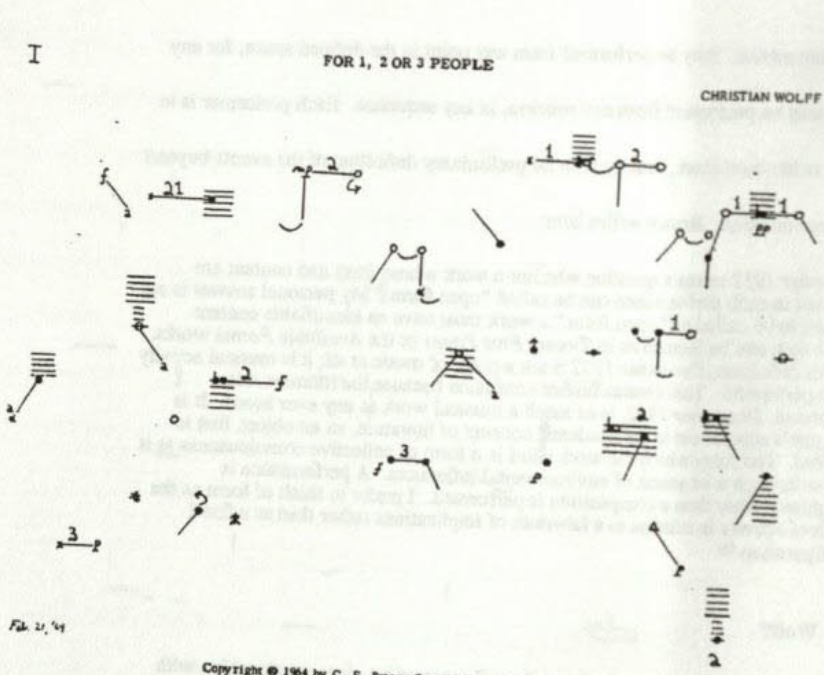

Figure 2.2 Christian Wolff, *For 1, 2 or 3 People*

Scores from this period, In particular *For 5 or 10 Players* (1962), *In Between Pieces for Three Players* (1963), and *For 1,2 or 3 People,* (1964), include a detailed new notation specifying musical events as the result of a process of interaction with the sounds of other performers, or the environment. Figure 2.2 shows the first page of *For 1, 2 or 3 People.* This notation is most often indeterminate with respect to pitch, (notes on staves specifying either treble or bass clef depending on the instrument), and rhythm (black notes are short,

white notes are of any length). More highly specified are the conditions for performer sound interaction. Symbols specify relationships such as, "Play after a previous sound has begun, hold until it stops," or, "Start at the same time (or as soon as you are aware of it) as the next sound, but stop before it does."[30]

Other symbols describe the number of tones, the number of timbre, and qualities such as "a sound in some respect dissonant with what immediately precedes," "a sound as far away as possible, in some aspect, from what immediately precedes it," or "a sound in a middle place, in some respect, of the sounds around it."[31]

For 5 or 10 players, has an elaborate formal scheme which sets forth many ways in which the ten pages of the score could be used in different performance situations with different numbers of players:

> A performance should use, if five players are playing, at least pages 1 to 5, one for each player, or pages 6 to 10 (players 7 and 8 should each have a copy of page 7/8), or both, player #1 using pages 1 and 6, #2 using pages 2 and 7, etc.; or, for a longer performance, each player can be given copies of all ten pages.[32]

At a certain point during a performance, a signal is given and all players are to play a page consecutively, from left to right. When not playing consecutively the players may go from

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30 Christian Wolff, *For 1, 2 or 3 People.* (New York: C.F. Peters Corporation, 1964), Instructions.

31 Ibid.

32 Christian Wolff, *For 5 or 10 People* (New York: C.F. Peters Corporation, 1963), 4.

any event to any other, as long as they follow the rules for coordination at all times. One of the players in the ensemble acts as a conductor deciding on a general procedure for a performance and signalling group events such as the reading of a page consecutively, the start, and the finish. A performance can be of any length.

Electro-Acoustic Music

The history of electro-acoustic music is filled with numerous attempts to integrate human musical activities and values, with the ever advancing capabilities of technology. Of particular interest to this discussion are approaches to electro-acoustic music composition which attempted to find new ways to combine formalized abstract structures (composition) with spontaneous performance processes and improvisation.

Tape Music

The genre of tape music introduced an unprecedented degree of control for the composer but also introduced the problem of how to integrate this new media into human performance contexts. One significant issue has been the coordination between live performers and the fixed medium of tape.

In most cases, the rigidity of the tape playback in performance became a significant aspect of the performance practice and coordination. In Mario Davidovsky's *Synchronisms* series, scored events for live performer are coordinated tightly with sounds on tape. The consistency of the tape accompaniment allows the performer to take liberties while relying

on the tape playback to anchor the performance. Davidosky observes:

> Despite the rhythmic aspect of the tape being totally unyielding, performers can still do small rubatos, taking some freedom in the interpretation, and somehow compensate for it, because the tape is totally reliable in sustaining the rhythm.[33]

Conductor Jan Williams notes a quality of sound on tape whereby familiarity with the static media becomes a new form of aural transmission in music:

> Since the tape was always moving at the same speed, it became like an aural score, and coordinating with it in the process of rehearsal became easier. The fixed nature of the tape allowed me to rely on it. I don't know how it happened exactly, but it seemed to be possible to develop a sense of the passage of time not based on seconds but based on events on the tape.[34]

In other cases, composers developed a more flexible coordination between tape and performer. Lukas Foss' *MAP*(1971) coordinated interaction between performers and recorded sounds on tape as a game. At certain points in performance, the instrumentalists are asked to imitate the sounds on tape. Joel Chadabe notes the following in his book *Electric Sound:*

> When he began to work on *MAP* in 1970, Foss' intention was to create a piece in which performers would improvise with electric sounds on tape. As rehearsals progressed, however, he concluded that the electronic sounds were functioning too much as a score; and that realization came more or less at the same time as the idea of creating a game, the rules for which would produce, as he put it, "a music that would happen by itself."[35]

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33 Joel Chadabe, *Electric Sound, The Past and Promise of Electronic Music* (Upper Saddle River,New Jersey: Prentice Hall, 1997), 69.

34 Ibid., 69.

35 Ibid., 71-72.

Tape music which incorporates live performers changes our engagement with sound, and our means of musical transmission. As composers of tape music, we ask the performer to do more than learn a written score and follow its directions; the performer must also aurally assimilate the tape part in great detail. When this can be accomplished, the nuance and subtlety allowed the electro-acoustic music composer can be directly transmitted to the performer in sound, rather than indirectly through notation. This new relationship points out the power of the electronic media as an organizing structure in and of itself, even without a traditional written score. When graphic notations of the tape are included in this relationship they function as a memory aid, only useful once the taped sounds have been learned.

Performance with Live-electronics

The history of live-electronic music performance is a vast topic also well beyond the scope of this discussion. One particularly interesting issue is how live-electronics, growing out of studio production techniques, coordinated fixed sound sources, transformative processes and spontaneous musical interaction. Electronics offer new modalities of musical interaction which are in many ways controllable, but in other ways, often chaotic. In many cases, live-electronic performance incorporated human improvisation with dynamic sound transformation designs. Numerous musical groups emerged in the 1960s and 1970s, each with a different approach to structuring sound,

performance, other media, technology and interaction. Significant among these groups were the League of Automated Music Composers, the Hub, the New Music Ensemble, the Once Group, the Sonic Arts Union, and Musica Elettronica Viva (MEV). Many ideas about the relationships between group improvisation, composition, form and electronics catalyzed with MEV.

MEV consisted of Allan Bryant, Alvin Curran, Jon Phetteplace, Carol Plantamura, Frederick Rzewski, Richard Teitelbaum, and Ivan Vandor. It was formed as a collective in Rome in 1966 for the creation and performance of live-electronic music. In writing about the group, Frederik Rzewski offered this notion of dynamic musical structuring in a technological context:

> Scores and tapes, when used, do not constitute the final objective form of the work but are rather reservoirs of stored information: sound sources, like the instruments themselves subject to further operations during performance. In this frame the art of composition, unlike the traditional discipline, becomes a preparatory ritual to music: it extends the soldering of transistors, the arranging of concerts, and all actions which create the conditions for the possibility of music. It becomes basically an art of interpretation rather than of construction: the categories which it employs serve, not to define the fixed characteristics of objects, but to define fields of actions whose final course is decided in the momentary encounter with unpredictable life situations. Above all its materials are not known and limited but consist of new and in part irrational phenomena directly connected with electronics: the performer's entire body and his sense of identity are affected by such things as intermodulation and feedback. It strives toward a new concept of harmony which goes beyond mere formal relations and deals with new ones such as that existing between many individuals considered not as mere "performers" but as living bodies, and the relation created between the individual and his own "double" - the electronically transformed signal issuing from the loudspeaker membrane.[36]

In a collage of quotes presented in *Source,* Rzewski offers the following insights:

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36 Frederick Rzewski, from "Groups," (*Source* 3/1, 1968), 66.

No problem in form or construction, the form is the method.

Instrumental music and interpretations as they are normally practiced are just a crude form of programming. Scores etc., are a primitive forerunner of punched cards.[37]

Live-electronics enabled a dynamic interaction and engagement with technology. In many cases, extremely simple constructs and processes had profound impacts on musical performance. Consider the tape-loop, this simple construct has virtually prompted its own genre; from Terry Riley's "*Mescalin Mix* (1960)," and "*Music for the Gift* (1963);" to Steve Reich's "*It's Gonna Rain*, (1965)" and "*Come Out*(1966)" which, along with his work with Terry Riley presenting "*In C*," ultimately inspired numerous repetitive and phasing compositions for live musicians;[38] to real-time implementations of Alvin Lucier's "*I am Sitting in a Room*(1980);" to the use of commercial digital devices which mimic the qualities of the tape-loop (such as the Electro-Harmonix "16 Second Delay,"and the Lexicon "Jam Man") by performers Robert Fripp, Bill Frisel, David Torn and Wolfgang Muthspiel. The structure of the tape-loop represents the possibility of "improvising" something that instantly takes on the fixed qualities of a score or composition. This recording can then be played-back, over-dubbed, further transformed, or saved as a sort of auxiliary musical memory to be brought back later within a

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37 Ibid., 67.

38 Geoff Smith and Nicola Walker Smith, *New Voices - American Composers Talk About Their Music*, 215.

performance.

Computer-aided Composition and Interactive Music Systems

Computer-aided composition (CAC), predates the use of the computer as a medium for sound-synthesis. Since the mid-1950s[39], it has prompted a rich body of diverse compositions and musical thought. In the last ten years, numerous generalized programming environments for musical composition have been implemented including Miller Pucket's MAX, Paul Lansky's Cmix/ MINC, and others. These environments allow the composer to make a library of dynamic compositional tools. These tools can be combined and customized as needed in the creation of new works.

In non-real-time environments, an algorithm can be used to audition numerous instantiations of a compositional idea. The composer can then choose, edit and mix the results to fit his needs in the creation of tape music, or scored music for live performers. Once a compositional structure has been developed it can be used in the creation of a series of works with similar features; consider Paul Lansky's series of *Idle Chatter* pieces, or Charles Dodge's fractal compositions, *Profile, Roundelay* and *Viola Elegy*. By altering relatively "high-level" features of the compositional structure, greatly differing compositions which are clearly "cut from the same cloth" can result.

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39 L.A. Hiller "Music Composed by Computers - a Historical Survey," from H. Lincoln ed., *The Computer and Music*(Ithica: Cornell University Press) 42 - 96.

A recent significant extension of this line of development has arisen with the ability of computers to realize compositional algorithms in real-time. Composers can now interact directly with the computer and receive immediate feedback. Real-time algorithms can also be used in performance, as Rowe states:

> By attaining the computation speeds needed to execute compositional algorithms in real time, current computer music systems are able to modify their behavior as a function of input from other performing musicians. Such changes of behavior in response to live input are the hallmark of interactive music systems. Interactivity qualitatively changes the nature of experimentation with compositional algorithms: the effect of different control variable values on the sounding output of the method can be perceived immediately, even as the variables are being manipulated.[40]

CD-ROMs and Interactive Media

The common availability of multimedia-equipped computers has encouraged the development of the CD-ROM. This medium allows a previously prohibitive amount of data to be distributed to a large audience, and is the first common format for the distribution of high-quality interactive audio/visual productions. Ranging from adventure games, to "make your own mix" rock videos, to "chamber music for CD-ROM," the artistic quality of this new genre is slowly developing. At the present time, few CD-ROMs amount to more than a slide show presentation of images with poor grade sound and primitive user interaction.

In 1992 Morton Subotnik released "*5 Scenes from an Imaginary Ballet*" as, "the

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40 Robert Rowe, *Interactive Music Systems*(Cambridge: MIT Press, 1993), 2.

first piece of music composed specifically for CD-ROM."[41] This work offers CD-quality audio of Subotnik's compositions in addition to digitized images and texts by Max Ernst. The computer interface allows the listener to choose the order of movements, and the option of experiencing the pieces with "composer's comments," brief notes about the composition which appear on the screen during a performance. While a movement plays there is virtually no user-interaction except to stop the play-back.

Laurie Anderson has also created a composition for CD-ROM in collaboration with designer Hsin-Chien Huang entitled, "Puppet Motel."[42] This is a much more dynamic work incorporating audio, video clips, animation, and graphics into an interactive "performance piece." There are numerous game-like interfaces to indeterminately structured sonic and visual events. In conjunction with the CD-ROM, Anderson established a world-wide-web site accessible to "Puppet Motel" users allowing them to continue to interact with new material within the structure.

The CD-ROM addresses current problems in transporting large amounts of data needed for sound and visual images. It also addresses industry's need to create a common format for the mass-distribution of dynamic media structures. As the internet grows and

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41 Liner notes for Morton Subotnik's CD-ROM, "All My Hummingbirds Have Alibis" (New York: Voyager, 1992).

42 Laurie Anderson, Hsin-chien Huang, "Puppet Motel" (New York Voyager, 1995).

reaches necessary speeds for streaming large amount of data, other, less commercial, forms of meta-compositional distribution are developing as well. Some composers distribute their work through special interest groups developed along a particular computer music platform, such as the language MAX. Other compositions are archived at various sites as executable computer programs. Already, pieces such as Brad Garton's meta-composition *Looching*, which spontaneously creates automatic background music on your computer while you work, have circled the globe providing a technologically mediated, one-to-one interaction between composer and listener. As witnessed by the development of web-sites for the *Musikalisches Wurfelspiel*, an increasing number of interactive sites for dynamic musical dissemination are being developed. This is creating a new model of musical engagement and transmission, a new "chamber music" developing through technology.

Improvisation

A significant difference between improvisational and pre-composed musics is in the collaborative efforts of the participants in performance. As Roger Dean States:

> One major feature of improvisation... is that it permits interaction between individual musical creators at the time of conception of music; in this it is unlike composition.[43]

For improvisation, unlike most western musical production in the last 200 years,

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43 Roger Dean, *New Structures in Jazz and Improvised Music Since 1960* (Philadelphia: Open University Press, 1992), x.

> can involve simultaneous participation of several co-creators, Composition rarely involves more than one musician; and the various performers who contribute to the final process act later, and thus do not interact directly with he composer, and virtually never change the written form of the work. This interaction is one of the key attractions of improvisation, and one of the features that make it at least as valuable as composition. Indeed, composition by individuals working alone is not a widespread activity in most cultures; improvisation by groups is more widespread and is also used in the production of musical entities learned by rote, and which remain firmly fixed (and hence 'composed') for several performances.[44]

Many improvisors speak of their art as a "way of life," a constant process of growth and self-evaluation where one is always in a state of preparation for the next performance. No composition, recording, or performance is an end in itself but rather a frame in a life-long development, a constant process of practicing, performing, and listening:

> ...the popular definitions of improvisation that emphasize only its spontaneous intuitive nature - characterizing it as the "making of something out of nothing" - are astonishingly incomplete. This simplistic understanding of improvisation belies the discipline and experience on which improvisors depend, and it obscures the actual processes that engage them. Improvisation depends, in fact, on thinkers having absorbed a broad base of musical knowledge, including myriad conventions that contribute to formulating ideas logically, cogently, and expressively. It is not surprising, therefore, that improvisors use metaphors of language in discussing their art form.[45]

Jazz

Jazz is an example of an aural tradition of improvisation which demands considerable study and assimilation of a musical "language" including: a body of standard tunes, harmonic progressions, melodic patterns, and rules for harmonic alterations and

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44 Ibid., xiv.

45 Paul Berliner, *Thinking in Jazz, the Infinite Art of Improvisation* (Chicago: The University of Chicago Press, 1994) 492.

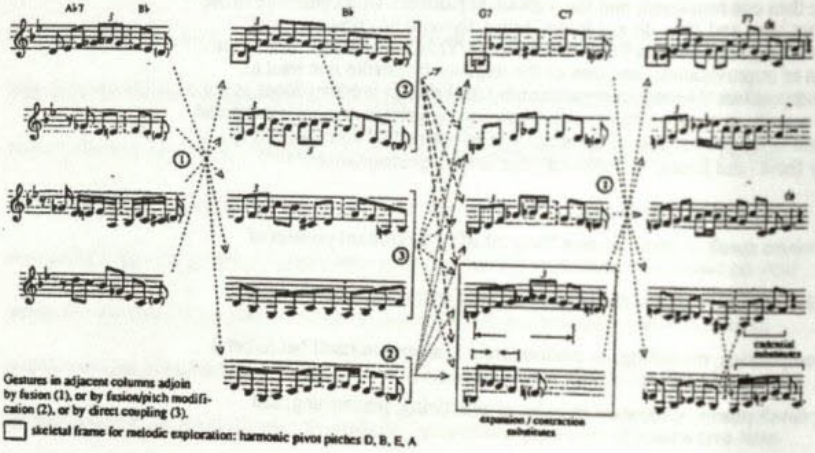

Figure 2.3 Expanding networks within a community of ideas. From Berliner, Jazz, 561

substitutions. As stated by Paul Berliner:

> The language metaphors adopted by jazz artists to describe their conceptions convey more than the notion that, within the bounds of their unique language system, "musical ideas" should have substance. They also suggest that, for improvisors, the patterns are not ends in themselves, but have ongoing implications for thought. In this light, the interest in exploring the relationships among ideas is fundamental to both musical and verbal thinking. ...improvisors experiment with vertical patterns within different parts of a piece's harmonic-rhythmic form where their blend assumes distinctive attributes. At the same time, improvisors pursue linear relationships of their ideas by combining vocabulary patterns in different ways to create new phrases.[46]

Figure 2.3 illustrates a common conceptualization of one way that jazz musicians combine

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46 Ibid., 184.

patterns to construct a musical line. As one can see, this diagram strikingly resembles the meta-compositional approach employed by Mozart in his *Musikalisches Wurfelspiel.* Of course this is not the only approach to constructing musical lines in jazz.

In the life-long discipline of becoming a jazz improvisor the player *composes himself.* The experiences of the player become a meta-compositional structure allowing numerous instantiations of a musical work which are spontaneous yet drawn from a considerable concentration on developing a controlled musical language:

> As their personal goals compel them to deepen their general understanding of music and to establish original voices within their own tradition, jazz improvisors fundamentally devote their lives to music composition. This remains true whether they store, edit, and revise their ideas by ear, visual imagery, and instrument, or carry out similar procedures with the aid of writing and recording. It remains true whether the object of an artist's activity is to assemble ideas into a fixed composition, or to continually rework them into transient art works with but fleeting identities.... For jazz musicians, each situation simply imposes different kinds of compositional conditions on musical invention.[47]

Free Improvisation

Numerous streams of activity, from contemporary jazz to indeterminate notation in composition, converged in the 1950's and 60's to influence new approaches to musical improvisation. Much of this activity centered on breaking down established musical roles and pre-conceptions of musical production. In improvisation stemming from a jazz tradition, the functional roles of the participants within the ensemble were loosened, freeing the "rhythm section" players for more coloristic, textural and soloistic playing.

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47 Ibid., 492.

The basic texture of "soloist and accompaniment " gave way to a more diversified, group musical statement. Along with this came a departure from the focus on repetitive tune structures, time, beat, pitch and functional harmony. Many composers explored new ways of structuring the composer/ performer/ listener relationship by allowing more improvisational freedom in performance. Chance and environmental sounds were allowed into the creative processes of composition and performance. New technologies, world musics, and new instruments were incorporated in the realization of music of all types.

As with electronic music, groups and musical collectives became an important force in the development of new music. Significant improvisational groups included the John Coltrane Quartet, Circle, Association for the Advancement of Creative Musicians (AACM), AMM, MEV (mentioned above), Jazz Composers' Orchestra, Sun Ra and his Arkestra, New Phonic Art, and the Miles Davis Quartet. Important figures who worked in many contexts included Pauline Oliveros, Cecil Taylor, Anthony Braxton, and George Lewis. For a full discussion of improvisational music in the last several decades, Roger Dean's book, "New Structures in Jazz and Improvised Music Since 1960,"[48] and Derek Bailey's book, "Improvisation, Its Nature and Practice in Music"[49] provide invaluable

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48 Roger Dean, *New Structures in Jazz and Improvised Music Since 1960* (Philadelphia: Open University Press, 1992).

49 Derek Bailey, *Improvisation, Its Nature and Practice in Music* (New York: Da Capo Press, 1992).

resources.

Pauline Oliveros

Throughout her life Pauline Oliveros has been active in many forms of music making including composition, improvisation, tape music composition, and live electronic performance. She sees the practice of "deep listening," as a common thread in all of her activities, describing it as the pathway to personal change.[50] Her music can involve a process of meditation, attunement to other participants, and to the environment. It is often not written in a conventional fashion:

> The range of notational practices employed to present my work as a composer includes conventional staff notation, graphic notation, metaphors, prose, oral instruction and recorded media.[51]

Because of this, her music often presents a difficulty in terms of its presentation and appreciation within the concert paradigm,[52] and when approached with standard analytical tools.

> My way of composing is seen either as a substantial contribution to the field or it is dismissed as not real music because it is not written in a conventional way and cannot be judged conventionally. It is dismissed because of a lack of written notes, or because participants are asked to invent pitches and rhythms according to recipes or to respond to metaphors. Musicians accustomed to reading notes and rhythms are often shocked by the bareness of the notation compared to familiar

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50 Geoff Smith and Nicola Walker Smith, *New Voices - American Composers Talk About Their Music*, 207.

51 Pauline Oliveros, *The Roots of the Moment: Writings, Horspiels and Poems 1981-1995* (Drogue Press, 1995), 6.

52 Ibid., 9.

> conventional scores which direct their attention to specific pitches and rhythms which seem to them predictable and repeatable. What I value is the more unpredictable and unknowable possibilities that can be activated by not specifying pitches and rhythms.[53]

In her composition she forms the context for music and group communication:

> My music is interactive music. It is interactive in the sense that the participants take a share in creating the work rather than being limited to expressively interpreting pitches and rhythms. I have composed the outside forms, the guideways for ways of listening and ways of responding. These forms and guideways with appropriate application give the participants a creative opportunity to compose and perform simultaneously in collaboration with me and to expand their musicianship.[54]

Although her music is introspective and meditative, she feels that a concert audience could enjoy a performance, and consider it as art music:[55]

> The central concern in all my prose or oral instructions is to provide attentional strategies for the participants. Attentional strategies are nothing more than ways of listening and responding in consideration of oneself, others and the environment. The result of these strategies is listening. If performers are listening then the audience is also likely to listen.[56]

John Zorn

John Zorn has written a number of pieces which deal with the structuring of musical material as a dynamic process in an improvisatory performance context. Coming from an improvisational background he is sensitive to the individual talents and psyche of

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53 Ibid., 6.

54 Ibid., 6.

55 Ibid., 8.

56 Ibid., 6.

the performers he works with:

> What I was really fascinated with was finding a way to harness these improvisors' talents in a compositional framework without hindering what they actually did best - which is improvising. An improvisor wants to have the freedom to do anything at any time. For a composer to give an improvisor a piece of music which said, 'play these melodies - then improvise - then play with this guy - then improvise - then play this figure - then improvise', to me, that was defeating the purpose of what these people had developed, which was a particular way of relating to their instruments and to each other. And I was interested in those relationships.[57]

In his "game pieces" dating from the early 1970s he often provoked events by specifying musical relationships rather than content, "you can play with this person if you choose, or in alternation with this person," the sounds and instrumental approaches were left to the performers. These pieces originally were written based on a time-line, later he moved to a "non-structure" similar to Brown's open-form:

> Where I really started eliminating the time-line, eliminating the idea that a composer has to create an arc, was in a piece like *Cobra* where the sequence of events can be ordered at any time by anyone. There, I just create relationships, abstract concepts that the players can order any way they want, so that, at any moment in the piece, if they want to do something like play solo or play duo, or have the whole band play they can actualize that.[58]

In his ensembles he created a small society, empowering the participants to control their own musical activities. He compared the dynamics of the ensemble to a "psycho-drama," and was interested in the way that various performers reacted to the new musical context:

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57 Derek Bailey, *Improvisation, Its Nature and Practice in Music* , 75.

58 Ibid., 76.

> Some players are really kind of conceptual, thinking about structuring a piece of music, using these signals and trying to create some kind of compositional flow in their heads spontaneously. While others are, you know, creating problems. I think I am that kind of player. Bill Frisell is the kind of player who sits back and lets everybody else make the decisions and just plays his butt off. Ultimately he was the one who was making the sound of the music while other people were dealing with the structure of it. Those are all valid positions to be in the society that exists on stage when these pieces happen.[59]

The D.J.

The popularity of the "D.J." in contemporary urban culture illustrates the power and wide-reaching implications of dynamic interactions with electronic media in performance. The tools of the D.J. are the turntable, the mixer and an amplification system, or their digital analogues. However, as "Fab Five Freddy" describes:

> The DJ is, in fact, the first widely accepted musician to use information as a musical instrument: that is, information, being recorded music or records.[60]

The D.J. began as an entertainer playing dance records for friends. In the early 1970s, Kool Herc, a Jamaican D.J. living in New York, introduced a technique called "break-beat deejaying," which is mixing identical records on two turntables to repeat the musical "breaks," the instrumental sections between verses of songs, indefinitely for dancing. In the mid-seventies, Grand Wizard Theodore introduced the technique of scratching; rapidly spinning a record to achieve a rhythmic or percussive effect. At this

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59 Ibid., 78.

60 Introduction to Steven Stancell, *Rap Whoz Who* (New York: Schirmer Books,1996), v.

time D.J.s began using multiple turntables to play portions of breaks as accents over the same, or other, recordings. Later, the digital technology of samplers allowed the D.J. to record, transform, loop and repeat breaks at the push of a button. All these approaches are summed through the mixer to become "the mix."[61]

Paul Miller a.k.a. "DJ Spooky"

Paul Miller, a philosopher and writer who performs under the name "DJ Spooky that Subliminal Kid," sees his work as standing at the crossroads of youth culture, semiotic theory, and conceptual art. He has this view of the role of the D.J.:

> In the world of the DJ, the process of cutting, scratching, and transforming (rapidly switching between line/phonograph inputs on a mixing board, thus making the transition from sound to silence become percussive) reconfigures the turntable away from an object of passive reproduction. The turntable in this milieu becomes an instrument of synthetic replication. The characteristics of inscription and amplification create a new form of audio collage that allows for the rhythmic manipulation of sonic material. In this sense the DJ acts as a message source. The amplification of sound creates an immersive environment of acoustic space.[62]

For DJ Spooky, the combination of familiar sound sources in an unfamiliar context creates new philosophical implications for "the mix":

> The direct incorporation of previously existing sound source material into an aural text has had implications far outreaching any critique of appropriation. It obeys a logic of bricolage that contains objects moving at different cultural velocities, and creates a multi-valent temporal structure that is presented simultaneously. This is

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61 Ibid., viii.

62 Paul D. Miller, "Cartridge Music: of Palimpsests and Parataxis, or, How to Make a Mix." Unpublished paper, available online: http://www.wilder.net/stc/asphodel/milledi.html.

what we call "the mix."[63]

The popularity of "electronic music" is growing every day. "Like it or not, the Next Big Thing is us," proclaims a recent editorial in "Urb" magazine, "What will the surge of attention do to the creativity and mystery of our vital DJ subculture?"[64] A recent article about DJ Spooky published on the internet describes the relationship between contemporary electronic music and popular culture this way:

> It's paradoxical that a technologically advanced, urbane music should be as rooted in the community as, say, Cajun fiddle music in Eunice, Louisiana. "I say this over and over again," Miller insists. "To me electronic music is, in a way, the folk music of the 21st century. Instead of, say the 20's, where you had everyone who knew a blues riff playing a guitar, you now have everyone who knows certain beats and things like that putting them together and then circulating them -- this scene is about mixing and mix tapes.[65]

For the most part, D.J. mixes have been dance oriented. Miller's work departs from this to some extent:

> The idea, overall, is to create an environment that people want to move into and physically become immersed in. You can dance to it, but you can also sit down, you can walk around, some people stand still. It's definitely not about one pounding beat all night and people feeling like they're in a big space and they have

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63 Ibid.

64 Raymond Roker, "Smells like teen spirit... Again!" *Urb (Ultra)* magazine. V. 7, #53. March-April, 1997) 10.

65 Jon Garelick, "DJ Spooky patrols the virtual dance city." Phoenix Media Communications Group. http://www.bostonphoenix.com/alt1/archive/music/reviews/11-28-96/DJ_SPOOKY.html

to dance.[66]

Problems in Analysis

The examples presented in this chapter have, for the most part, viewed musical structure as the result of a dynamic interactive process. Many of them stress the ideas of spontaneity or collaboration in performance. If a musical work is, as Brown stated, "a process, rather than static and conclusive," and the act of composition includes, as Rzewski suggests, "all actions which create the conditions of the possibility of music," what is the purpose or relevance of an analysis of the result ? Analysis often serves to parse a composition or performance into time-based units, comparing their qualities and describing their continuity. This view serves structures which are transmitted as linear time-based forms, pieces written with the approach Brown describes as "constructivist:"

> ...the generating of a rational distribution of units, aggregates, densities, and qualities of sound elements; the numerical manipulation of micro-elements or structures of musical materials to obtain a rational evolution and generation of a macro-form as a quasi-organic growth process.[67]

However, for musical works with a dynamic, process-oriented form, time-based analysis of the result may not be particularly valid beyond that particular instantiation. It becomes an evaluation of the performance not the meta-compositional framework. We find

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66 Ibid.

67 Earle Brown, "Form in New Music" (*Source* 1/1, 1967), 49.

ourselves in the position of the proverbial blind man who, after his encounter with an elephant, analyzes its tail with the hope of uncovering the true nature of the beast.

What then may constitute a meaningful investigation of a meta-compositional structure? We will have to take into account the process, and context of the musical activity as well as the results including: the preparations of the composer and the performers, the properties of the prepared materials, the behaviors of dynamic elements and their scope of influence within the performance context, the ability and methods of transformation and combination of musical materials, the known irrational influences on performance, the experiences of the composer/ performer and listener, the established group concept and approach to the work, and the relationship to technology. All these elements contribute to what Brown often called the "poetics" of the musical work, those elusive elements that can be evasive or be lost in traditional musical analytical approaches.

Ethnomusicologist Ruth Stone has been a seminal figure in voicing similar concerns in studying the musics of other cultures:

> Interaction and communication within music events have scarcely been studied as process. To do so involves a concern for change as well as the transmission , reception, and feedback processes. The implications for incorporating process into ethnomusicological studies at the level of event are profound; rather than looking at a series of objects frozen in time and space.[68]

Obviously, these concerns can be applied to any musical investigation, especially that of spontaneously formed music such as meta-composition.

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68 Ruth Stone, *Let the Inside be Sweet, The interpretation of Music Event among the Kpelle of Liberia* (Bloomington: Indiana University Press, 1982), 6-7.

Conclusion

The examples in this chapter illustrate some of the many approaches to conceiving of music as a dynamic interactive process. These musical traditions and genres set the stage for meta-composition as a wide-spread method for preparing and coordinating musical performances. We see four primary threads emerging:

1) A paradigmatic shift in the focus of musical composition from a technique to create repeatable, identifiable musical structures, to that of designing dynamic systems for varied musical experiences: composition as object vs. composition as process.

2) The valuation (or re-valuation) of spontaneous human collaboration, and interaction with real and virtual environments in the creation of music. A breakdown of the composer/ performer/ listener triangle.

3) The use of the computer as a dynamic, sometimes intelligent, tool augmenting the creative powers of an individual in the creation and investigation of musical structure.

4) Electronic media taking on and extending traditional aspects of musical dissemination including oral/aural and notated traditions.

The following chapters, three through seven, will present several meta-compositional contexts in which I have been involved during my graduate studies at Princeton University.

It is my hope that these descriptions will provide insight into the rewarding musical activities and results that can ensue from a disciplined approach to the creation and performance of spontaneous musical structures.

Chapter Three

A Trip on *My Ship*

This chapter examines the performance of a jazz standard as a meta-composition. An important aspect of the investigation is the musical transformation which occurs within an ensemble through repeated performances of an improvisatory structure over a period of time.

The musical examples for this chapter are drawn from performances and daily rehearsals of a jazz trio consisting of pianist Jeff Presslaff; drummer, Cedrik Jensen; and myself. The examples are not "staged" to demonstrate the range of possible jazz interpretations of a given improvisatory vehicle. Rather, they present a record of our

process of group transformation during the period August 1995 to January 1996.

My Ship

In the course of our sessions the trio played music ranging from free improvisation to traditional jazz. When we played familiar tunes we would attempt to approach them in new and different ways each time, trying to express the essence of what made that tune unique, or perhaps create a new twist on its meaning. One of our favorite improvisational vehicles during this period was *"My Ship,"* a tune by Kurt Weill with lyrics by Ira Gershwin.

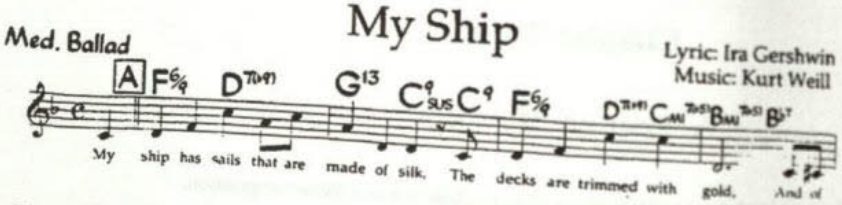

Figure 3.1 First phrase of *My Ship*

Figure 3.1 illustrates the basic structure of the first phrase of the tune. We were all familiar with the melody, standard harmonizations, common performance interpretations, and had played the tune many times with other performers in different contexts. The following examples are ten interpretations of the first phrase of *"My Ship."*

Ten Ship Shapes

CD II, *Sound Examples*, Index 1 (8/14/95)

This example is a fairly traditional rendition of the tune done in an early session. The piano interprets the melody with little embellishment stressing a constant quarter-note rhythm with the left hand. The drums play simple brush patterns only breaking from basic quarter-notes at the last beat of each two bar phrase. The bass line is slightly unusual in that it plays a counter-line to the melody starting on "off-beats" and emphasizing harmonic alterations such as the flattened ninth of D^7 in the first measure.

CD II, *Sound Examples,* Index 2 (8/14/95)

The piano plays the melody in a more abstract and fragmented fashion, the main deviations from the original melodic contours occur in the second and fourth bars. The bass plays dancing, syncopated counter-point; the drums begin to play more syncopated figures in the second phrase. The overall texture is sparse and quiet.

CD II, *Sound Examples,* Index 3 (8/21/95)

A textural change, the bass plays the melody in the upper register fragmenting and embellishing it. The basic melodic contours and principle notes are retained but they are changed to the point where an outsider may not recognize the tune. The quarter-note pulse of the ballad is still maintained by the drums and piano.

CD II, *Sound Examples,* Index 4 (12/28/95)

The feeling of the tune is altered through a highly rhythmic treatment. The piano's left-hand accents depart from the basic quarter-note pulse heard in earlier examples. The bass takes an active contrapuntal role. The drums still reference the quarter note feeling of the

slow ballad tempo.

CD II, *Sound Examples*, Index 5 (1/23/96)

A later version with a similar approach to the last example. The drums leave the slow ballad tempo and interact with the syncopated rhythms of the ensemble.

CD II, *Sound Examples*, Index 6 (8/23/9)

The piano plays the melody freely outside of a regular meter. The last obvious reference to the original tune is the ascending arpeggio based on the first four notes of the original tune. The bass plays a slow ascending line in free time.

CD II, *Sound Examples*, Index 7 (8/23/95)

Still outside of a regular meter, the bass and piano freely improvise on the melodic contours of the tune.

CD II, *Sound Examples*, Index 8 (9/11/95)

A similar free-melodic rubato treatment. Fragments of the tune are passed between the bass and piano, the drums roll and add textural color. At this point, the traditional roles of the instruments within the ensemble are almost completely relaxed.

CD II, *Sound Examples*, Index 9 (8/2/95)

The piano plays a series of sonorities re-harmonizing and outlining the shape of the first phrase. The interpretation is quite abstract and only key notes of the original tune are maintained.

CD II, *Sound Examples*, Index 10 (8/25/95)

The first two phrases of "My Ship" with an abstracted rubato bass melody. The piano accompaniment in the second phrase completely departs from the traditional harmonies of the tune and is purely coloristic and textural.

Analysis

As the trio played together over time, social and musical roles were relaxed, the structural formalities of the improvisational vehicles became more subtle. We consciously developed a multi-voiced texture rather than the traditional jazz relationships of soloist and accompaniment. As a bass player, this freed my voice from the task of continually articulating the rhythmic and harmonic structure, allowing me to contribute more to the textural flow of the music. As we played, we often freely left the repetitive structure of the tune's form and explored melodic fragments or other musical elements from the composition.

The jazz format gave us a structure which we were able to explore by varying "global" aspects of a musical form. We could easily change tempo, orchestration, solo ordering etc. We may have had a brief discussion of the arrangement before the performance ie: "Curtis take the melody," or "let's start free," or "let's swing this one." The group history of exploration was cumulative and contributed to each new version we performed.

Jazz standards in general present a sort of "recipe book" approach to the specification of an improvisatory vehicle. The basic form, melody and harmonization is

transmitted aurally, or through the mediation of recordings and "fake books." Additional experience in the interpretation of the composition is accumulated through playing, listening, and practicing.

The jazz tradition, and the concept of jazz as a tangible musical language, provides basic boundaries for the interpretation of tunes. Social conventions of the language, such as adherence to the formal and harmonic structure, faithful interpretation of the melody, and the conventional roles of instrumentalists also serve to maintain the practice across a wide range of performers, allowing jazz musicians who have never met to successfully perform together. As with compositions of western classical music, there may be interpretative boundaries outside of which the "composition" would cease to be recognizable. Strong proponents of the jazz tradition may even claim that more abstract interpretations of a form are not "jazz."

When playing regularly with a group, social conventions can be relaxed and musical relationships which are not customarily explored can be examined. In some cases, it may be necessary to verbally discuss in what contexts a certain "rule" may be broken. Such rules may determine, for example, whether the cyclical form of a composition must be maintained, or the extent to which a soloist maintains an individual voice, leading an "accompaniment" by the rhythm section. After playing together for some time a group takes on an identity of its own, formed by a synergy which is greater than the individual inclinations of the performers.

In this context, meta-composition becomes a combination of several things: a composed structural recipe, the "tune;" the individual concepts and experiences of the players; the group concept; and the tradition. In a larger sense, over the course of an evening's performance, a repertoire of standard tunes can be expressed meta-compositionally. Linkages and medleys of many tunes can form a larger relation between players and a knowledgeable audience. In performance, the participants "just play," forgetting past interpretations, and now striving for new ones. The new music becomes part of the tradition and informs subsequent generations of players.

This is meta-composition in a basically non-technological setting, although technology has affected the dissemination and performance practice. Marshall McLuhan viewed jazz as a break with the mechanization of past social and musical orders:

> If jazz is considered as a break with mechanism in the direction of the discontinuous, the participant, the spontaneous and improvisational, it can also be seen as a return to a sort of oral poetry in which performance is both creation and composition. It is a truism among jazz performers that recorded jazz is "as stale as yesterday's newspaper." Jazz is alive, like conversation; and like conversation depends on a repertory of available themes. But performance is composition. Such performance insures maximal participation among players and dancers alike. Put in this way, it becomes obvious at once that jazz belongs in a family of mosaic structures that reappeared in the western world with the wire service.[69]

The technology of recording enabled jazz performances to be captured and distributed, allowing improvisational music to be "published" as composition for the first time.

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69 Marshall McLuhan, *Understanding Media: The Extensions of Man* (New York: McGraw-Hill, 1964), 245.

However, recording technology does not capture the essential interactive nature of the genre.

Conclusion

Comparing this form of interaction with my work on the computer I found that the notion of meta-composition as a vehicle for creative exploration grew as central to my musical sensibilities. The interaction which occurs in these musical relationships creates a unique and meaningful bond which continues to grow and develop with time. Interactive musical contexts promote the development and transformation of dynamic interpersonal relationships. This experience can not be meaningfully modelled in the computer. Even if the external processes could be statistically mapped and reproduced, the resulting musical behaviors would be meaningless without the human relationships within the group.

Chapter Four

Algorithmic Mixing Pieces (1993-1995)

CD II, *Sound Examples*, Index 11: *Farewell* (12/18/93), excerpt[70]

This chapter will examine a group of recordings and compositions which I produced during my first year at Princeton University. During this period I explored the process of composition using algorithmic mixing scripts. While the resources available

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70 Complete composition is included on **CD I, *Compositions*, Index 2.**

were not sufficient to execute this algorithm in real-time, I was able to realize and record five different series of quadraphonic mixes, each series containing up to thirty "performances" ranging in duration from fifteen to twenty-five minutes.

Once I achieved consistent results with a meta-compositional structure, I treated my interaction with the computer much as I had my work with live ensembles. I began a disciplined commitment to producing and listening carefully to several complete "performances" each day. The more successful runs were cataloged and recorded.

My goals in this project were not only to examine the musical possibilities of meta-composition, but to experience a disciplined approach to developing music in collaboration with a computer algorithm over a period of time. I attempted to record the various instantiations of each meta-composition as a document of my interaction with the computer, without editing them or refining them at the time, much as I had done with performances and rehearsals of live ensembles.

Technical Notes

The meta-compositions described in this chapter were developed on the NeXT computer using a modified version of Paul Lansky and Kent Dickey's "rt" driver. A MINC script was used to create a 16-track mixing "score." The score would draw upon a set of source sound-files, excerpting, enveloping, transforming, and mixing them. The mix was written to computer disk and then recorded to DAT tape.

Each source sound-file was a small composition of its own. These files all started

with recordings of natural instrumental and vocal sounds such as: Jesse Norman singing *"Das Lied Von der Erde,"* orchestral textures of numerous sorts, excerpts of improvisations from the group "First Avenue," my own string-bass playing, samples of the "Beatles,"and Nancy Zeltsman playing marimba. Starting with performance gestures, especially improvisational gestures, lent the mix/performances a feeling of natural pacing and liveliness.

After selecting a basic set of source sounds for the meta-composition I would make several transformations of each. Usually these transformations involved combinations of computer processes which were relatively processor-intensive, such as synthesis-from-analysis routines, phase vocoding or windowed convolution. The transformations were edited, mixed, spatialized and formed into sub-mixes for the final automated "performances." I viewed these transformations as multiple "points-of-view" of each sound. The use of multiple "points-of-view" assured a final mix with unity and transformative qualities.

Numerous performances were needed to fine-tune the meta-compositions. Each "run" would not only indicate shortcomings of the mixing algorithm, but also the balance and diversity of the source-materials in terms of: loudness; register; pitch material; density; etc. Many of the early mixing results would be further processed and integrated back into the structure as source files making a sort of long-range feed-back cycle in the compositional process.

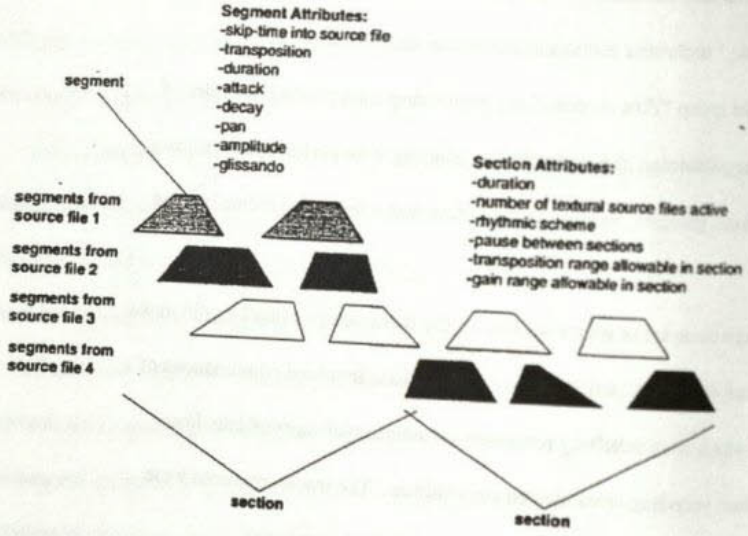

Figure 4.1 MINC Mix Algorithm

Figure 4.1 illustrates the basic concept of the MINC mixing script.[71] This diagram shows two "sections" or phrases from a performance. A section is a period of time, chosen at random within a range of acceptable values, where a particular pool of source files is used to generate texture. Other parameters chosen for each section include the number of files active, the rhythmic scheme used, the range of transpositions allowable, and the range of gain adjustment for each splice or "segment." Typically,the duration of a

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71 The complete MINC script is included as Appendix I.

section could range from five to twenty seconds, we see here an illustration of only a short excerpt from a full mix.

The diagram shows a progression through four source files within two sections of a performance. In the first section, the value, "three," was chosen from a range of acceptable values to determine the number of source files active. We see segments of source files one, two, and three enveloped and mixed. Other attributes chosen at random for each splice include: the skip-time into the source file, the transposition of the splice, the duration, attack time, decay time, pan position, amplitude, and amount of glissando.

In the second section of the diagram two source files are active: numbers three and four. The algorithm also determines by chance the number of files to be retained from the previous section. In this case, one source file has been retained: number four. All sectional parameter values are re-set.

The MINC algorithm continues in a similar fashion through a complete set of source files, perhaps fifty to one hundred for each performance. The ordering of the source files can either be composed or chosen at random. Multiple instances of the same source file, and files created by processing these sources, can create the recurrence of familiar features within a performance. Because of the mixing parameters chosen by chance for each section, the exact quality of the result will be different each time. By retaining of a certain number of source files from section to section, a coherent flow is maintained through the source materials. Attributes of pacing, attack, decay, transposition,

amplitude etc. were determined for each spice and each section according to high-level specifications in the MINC script. In this way, a musical performance which was recognizably a member of a particular meta-composition, yet possessing an individual musical character, could be generated by controlling a few powerful compositional "knobs."

Consider the following two examples drawn from the same series as *Farewell.*. Each example represents the opening section of a performance. A similar set of sound sources is traversed with slight changes to various parameters.

CD II, *Sound Examples,* Index 12: *Farewell* mix 3 (11/30/93), opening

CD II, *Sound Examples,* Index 13: *Farewell* mix 7 (12/2/93), opening

Obviously, the random selection of various segments from the source sound-files yields different gestures and chance correspondences in the musical textures. Perhaps the most striking difference in the character of the two examples is caused by the range of transposition values used, respectively. In the first example the long opening tones have a possible transposition range between no transposition, and a descending major sixth. The second example has a possible range of no transposition to a descending octave.

The Series

Several of the mixes created were presented as concert tape pieces, alone or with notated instrumental parts. A few performances were shared with others at various private listenings. The following is a short description of the various series produced

through my MINC mixing script.

CD II, *Sound Examples,* **Index 14: *solitude(s)* stereo mixdown (11/18/93), excerpt**

The first series which had what I considered satisfactory musical results was a set of approximately thirty mixes drawn from a set of sound-files composed primarily of processed acoustic instrument textures. About twenty of these mixes were designed as quadraphonic compositions by running two stereo scripts with slight differences between the ranges of selected parameters. The resulting paired recordings maintained the same large-scale form, but the articulation of details varied.

The sound example *solitude(s)* was the first mix which I named and played for others as a complete musical statement. It was the first time I felt that the individual sound sources and the algorithm fused to create a result with a unique musical identity.

CD II, *Sound Examples,* **Index 15: *Self Requiem* (12/5/93), excerpt**

C. Bryan Rulon asked me if I would collaborate with him on a piece for chamber orchestra and tape. I began a series of mixes based on computer processing of Bryan's improvisational ensemble, "First Avenue," and other instrumental sources. Bryan worked with me on several mixes, choose one of the results, and used it as a basis for the composition "*Self-Requiem.*" A quadraphonic mix from the series was performed in Taplin Auditorium as part of the Princeton Composer's Forum.

CD II, *Sound Examples,* **Index 16: *Convolution 9* (3/12/94), excerpt**

Chris Penrose produced an electro-acoustic music concert at Princeton in 1994

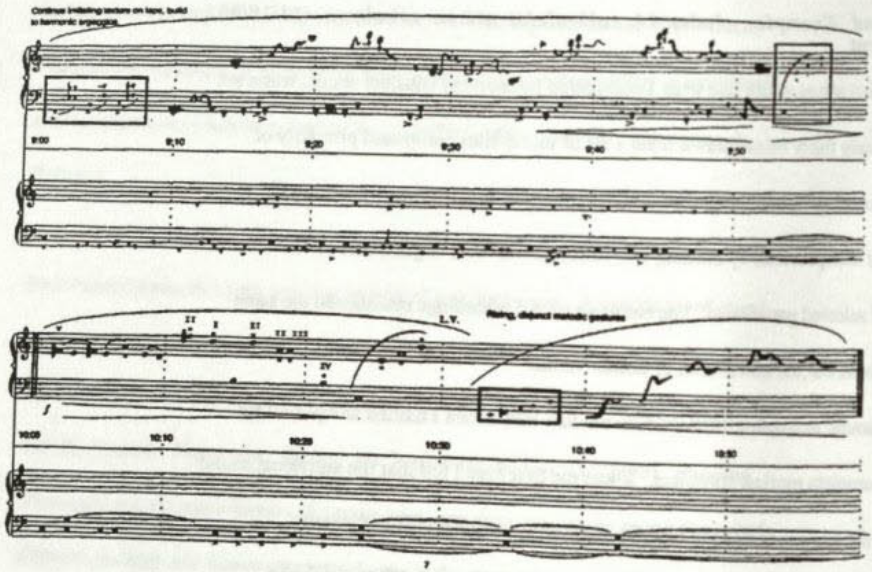


Figure 4.2 Score for *Double Bass* (excerpt)

called "Farming in the Desert," for which he solicited pieces from all the graduate student composers. I performed *Convolution 9*, one of a series of mixes based on processed sources from the Beatles *Revolution 9*, which I consider to be "arrangements" of the famous concrete composition.

CD II, *Sound Examples*, Index 17: *Double Bass* (1/8/94), excerpt
Robert Black, String Bass
CD II, *Sound Examples*, Index 18: *Double Bass* (1/8/94), excerpt
Robert Black, String Bass

The *Double Bass* series is a group of mixes based on computer processing of the sound of my string bass. I transcribed one of the mixes and scored a live instrumental part for bassist Robert Black. I kept the performance score fairly free, and attempted to describe texture and gesture to the performer in a similar way to that which I specified in the computer algorithm. (Figure 4.2)

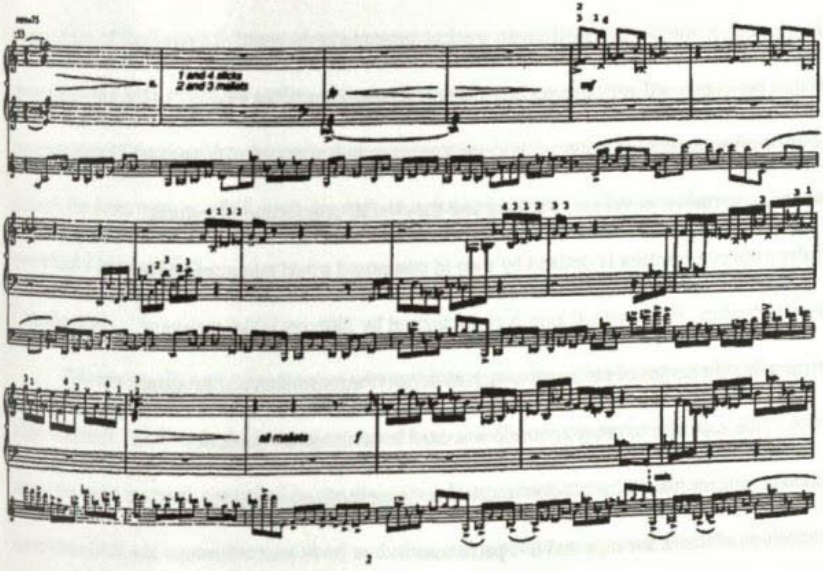


Figure 4.3 Score for *Zeltzimba* (excerpt)

CD II, *Sound Examples*, Index 19: *Zeltzimba* (1996), excerpt
Nancy Zeltsman, Marimba

I used my mixing algorithm to generate textures based on recordings of Nancy

Zeltsman's marimba. I arranged these textures 'by hand' to create the tape part for *Zeltzimba*, a composition for marimba and tape written for Nancy Zeltsman . In this work, the mixing algorithm was modified to allow a greater degree of specification for notes, sound-file transposition, and rhythm. The marimba part was scored in a detailed and specific manner to match the taped textures.(Figure 4.3)

Analysis

This approach to meta-composition sees musical structure as the result of a process which combines pre-composed sound materials into new relationships. The mixing algorithm was based on aspects of my experience as a composer in terms of rules regarding pacing, sonic transformation, envelope, phrasing and the overall progression of textures. Each particular meta-composition is defined by a set of composed sound resources, and a unique mixing algorithm. Each instantiation is characterized by different initial settings of global controls affecting ranges of parameters such as density, transposition and envelope characteristics. This approach to creating music was used to compose for numerous different contexts: concert music; installation; musical textures for improvisation; and notated composition of music for tape and live performer.

My relationship with technology during this project established several modalities of interaction. I was, first, a composer, carefully creating sonic materials for each network using standard tools for recording, analysis, synthesis and editing. I was then a meta-composer articulating compositional process through the creation of the particular mixing

algorithm and parameters of sonic transformation. Finally, I was a listener, experiencing the results of each run as a completely formed musical statement. This interaction gave me experience with large-scale form complex musical textures which I would not have been able to realize any other way.

While the algorithm introduced a certain degree of chance and algorithmic autonomy into the compositional process, I was still doing most of the "driving." The composition of the "gamut," the set of sonic resources for each meta-composition, determined to a large extent the quality of the musical surface of the results. The programming of the algorithm determined general aspects of form, quality and progression through the sonic textures. Still, each run took on a musical character of its own beyond that which I had specified.

Conclusion

This process allowed me to interact with technology much as I have interacted with a live ensemble. As I worked, I became more and more sensitive to subtle variations within the sonic materials controlled by the algorithm. Minor changes could have an enormous effect, and successive runs stood as distinct and separate musical statements.

While my interaction with the computer was educational, interesting and aesthetically pleasing, I found that I missed sharing the process of musical transformation with others, not through playing a final artifact in concert, but by participating in the exploration of sonic structures within an ensemble.

Chapter Five

Transitions

CD I, *Compositions*, Index 3: *Transitions*, 12/5/95 Taplan Auditorium.
Ron Quaglia, Guitar
Cedric Jensen, Drums
Curtis Bahn, Bass

After working with meta-composition in the production of tape-music, I became interested in applying a similar approach to the coordination of live musicians in performance. My goal was to create an interactive, score-driven, performance environment which could integrate my past work in improvisation, and computer-aided composition. I wanted to explore the performance possibilities of a musical score constructed as a hyper-

media document. *Transitions* was my first step in this direction.

During this time I was fortunate to work with an established jazz trio consisting of Ron Quaglia on guitar, Cedrik Jensen on drums, and myself. The group normally performed music ranging from jazz standards, to contemporary jazz originals and free improvisation.

While I enjoy playing music of this genre, I continue to be frustrated by the musical limitations presented by established approaches to jazz improvisation. In playing a standard form, the repetitive cyclical nature of the tune lends a common focus point of departure for the performance, but the range of textural and formal diversity which can be achieved while improvising usually remains quite limited. With free improvisation, the ensemble is released from traditional musical roles, but it is then very difficult to reintegrate concerns of rhythmic and pitch organization which are possible in more structured music.

In developing *Transitions* it was my goal to create a means of generating musical organization for a performance ensemble while still encouraging a free approach to improvisation. I attempted to maintain a vocabulary that the group had established through performance, abstracting it to create a more varied formal structure and textural development. One objective was to frame established "musical behaviors" within the interface, allowing the musicians to feel comfortable and natural while playing a score projected by the computer. If I were able to alter and control the large-scale form, yet maintain the established musical context of the jazz trio, I felt that the project would be a success.

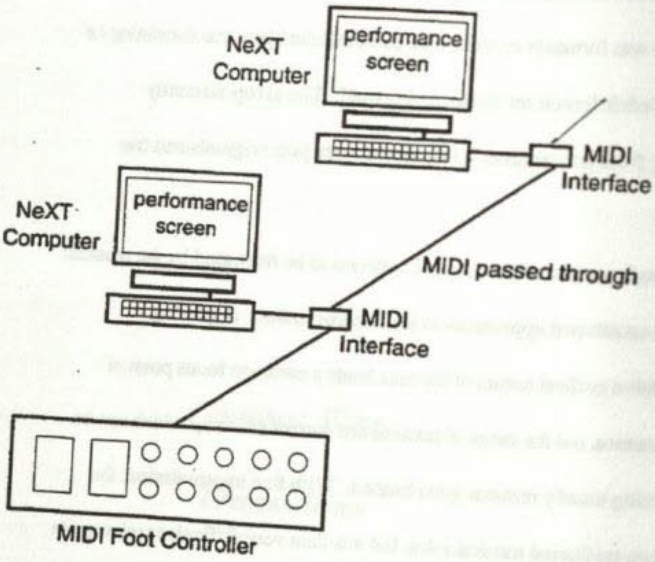


Figure 5.1. *Transitions* Technical Set-up

Set-up and Performance

Figure 5.1 shows the set-up for *Transitions*. A MIDI foot-controller sent messages to multiple NeXT computers, each running a copy of the interface software. This scheme distributed the effort of updating the performance information among the computers, and was the quickest (and easiest) solution to synchronizing graphic materials. The interface was designed using HyperSense a scripting environment for the NeXT computer modelled

after Hypertalk for the Macintosh platform.[72]

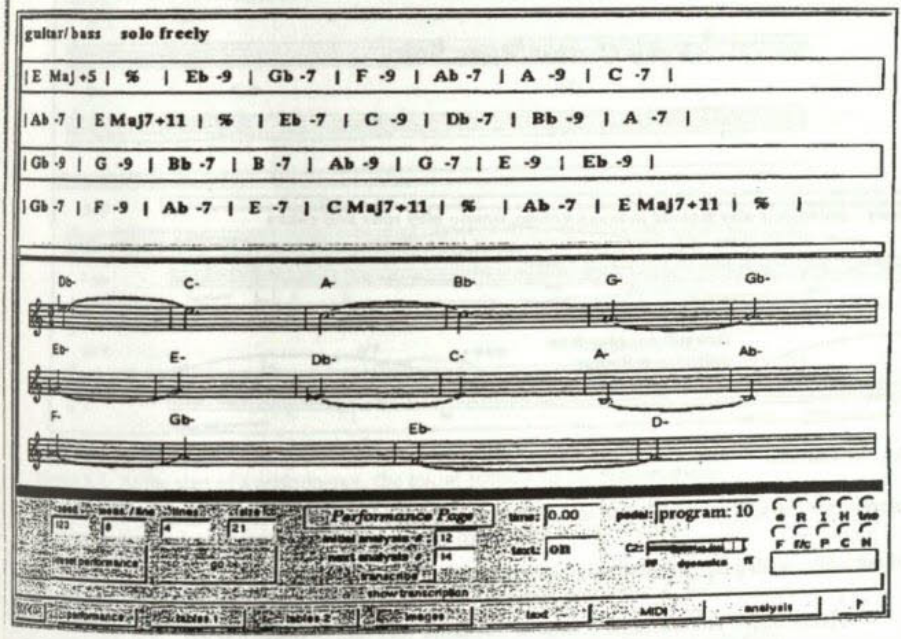


Figure 5.2. *Transitions* performance screen

Each computer displayed a split screen of performance information, and a control panel (Figure 5.2). Text, chord symbols, graphics, and traditional musical notation, could be broadcast to the ensemble. Since each performer had an individual copy of the interface, the score could be easily customized for individual instrumental parts and display

72 An example of a HyperSense script used for *Transitions* is included as Appendix II.

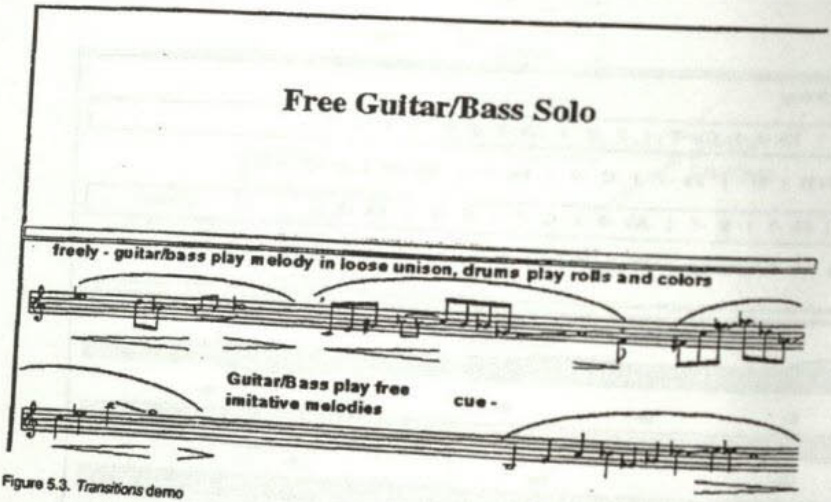


Figure 5.3. *Transitions* demo

preferences. The split screen allowed information to be updated constantly in performance without a disorienting lag or momentary blank screen.

A performance of *Transitions* combines traditional jazz improvisation and free improvisation. The screens indicate the next musical goal for the performers, who are left with the problem of how to get there, and within what time frame. The title of the meta-composition, "Transitions," reflects the idea that the real musical challenge lies in the freely improvised connections between notated events.

Demonstration

Figures 5.3 - 5.8 illustrate a short sample performance score of *Transitions*.

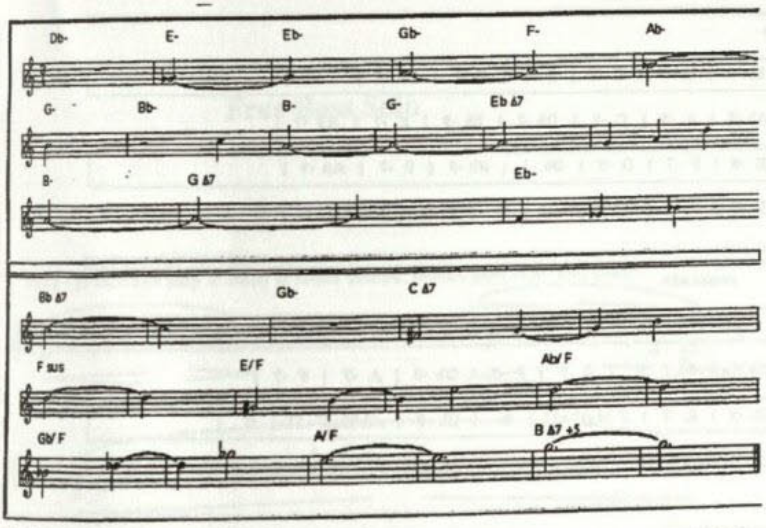


Figure 5.4. *Transitions* demo

Figure 5.3. At the start of a performance, the initial conditions for random event selection are supplied to the interface. These include the *type* of events that the performance will start with, and the seed for the random number generator. In this example, the initial event was drawn from a set of text descriptions for free improvisation. These text directions generally described functional or textural relationships between the improvisors such as: bass play alone, guitar with sparse accompaniment, all play soloistically, all play "conversationally," drum and bass duet with sustained guitar chords, etc.

The next event was drawn from a set of loosely notated ensemble textures. In performance, the bass player would start the piece, improvising freely. At a time of his

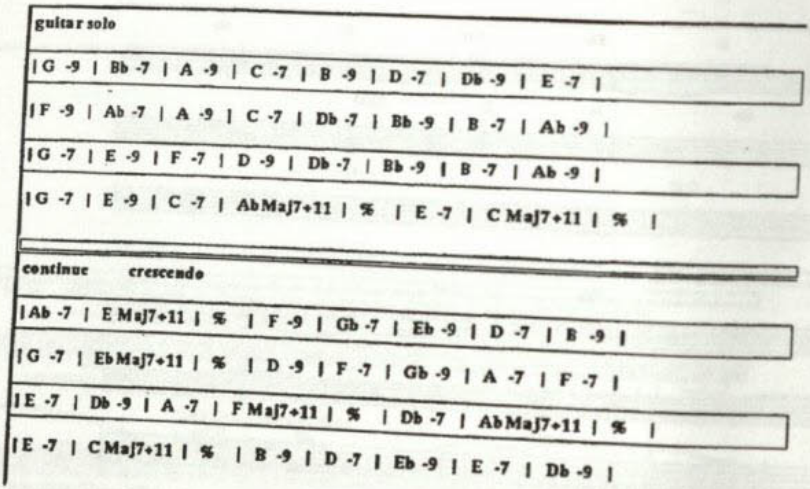


Figure 5.5. *Transitions* demo

choice he would cue the ensemble to begin playing the melody indicated in the bottom screen, which would be played almost heterophonically. As the bottom screen was being performed, a button on the foot-controller would be pressed indicating the type of event to be displayed or computed next, and the top of the screen to be updated.

Figure 5.4. The next two screens are the "head," or main notated melody of the abstracted jazz format. They were prepared and stored as computer graphics, as are all the examples of musical notation, and thus are not dynamically composed elements of the interface. This "tune" is an algorithmically composed jazz composition which was a part of the trio's normal repertoire. There are three basic harmonic motions in this tune which are found throughout *Transitions*: the first eight bars have minor seventh chords moving by

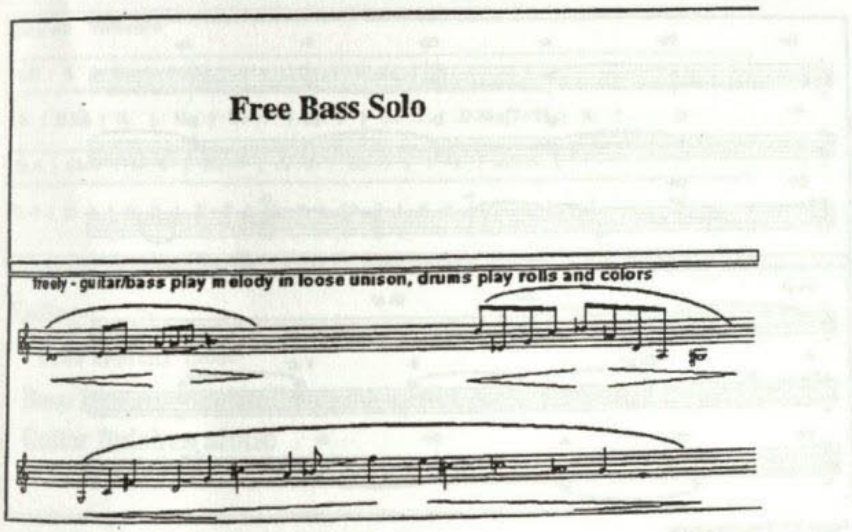


Figure 5.6. *Transitions* demo

ascending minor thirds, then a descending a half step. The next thirteen bars have a variable number of minor seventh chords falling usually by the interval of a major third to a major seventh chord. The last twelve bars are based on different chords over a pedal tone.

Figure 5.5. These screens contain chord progressions generated by the computer in performance using the same algorithm which generated the "head" (Figure 5.2). Variations of the root movement and irregular phrasing found in the original tune can be seen throughout the progressions in this and other figures. At the top of each screen are text indication for soloistic textures and dynamics.

Figure 5.6. Based on the choices of the ensemble member acting as conductor, the next

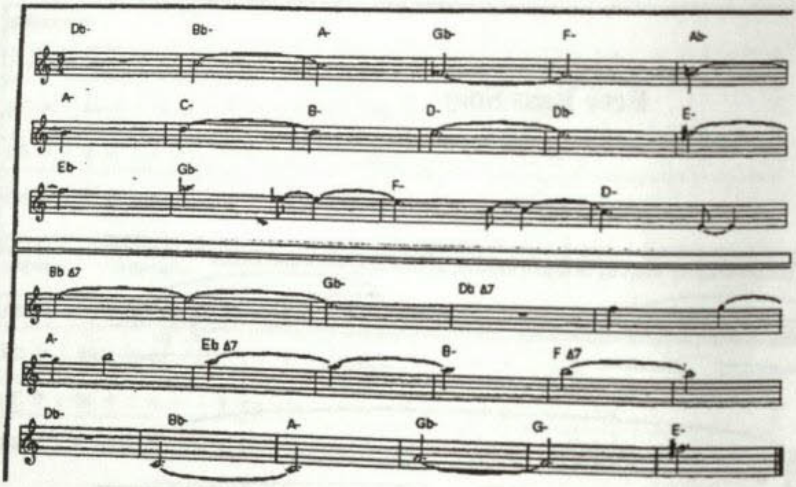


Figure 5.7. *Transitions* demo

two events create a free improvisatory texture, and are based on a loosely notated melody. The choices in these screens could also have been selected in the first two screens (Figure 5.3).

Figure 5.7. The next two screens are drawn from a pre-notated set of computer-generated variations of the original "tune." While it was a relatively simple task to have the computer generate strings of chords and display them to members of the ensemble, it was quite a different matter to have the computer generate thematic variations and notate them in real-time. Treating this as a feature rather than a "bug," numerous versions were generated and carefully notated. These musical fragments were given to the performers to be rehearsed. This turned out to be a good approach in the long-run as it reduced "sight

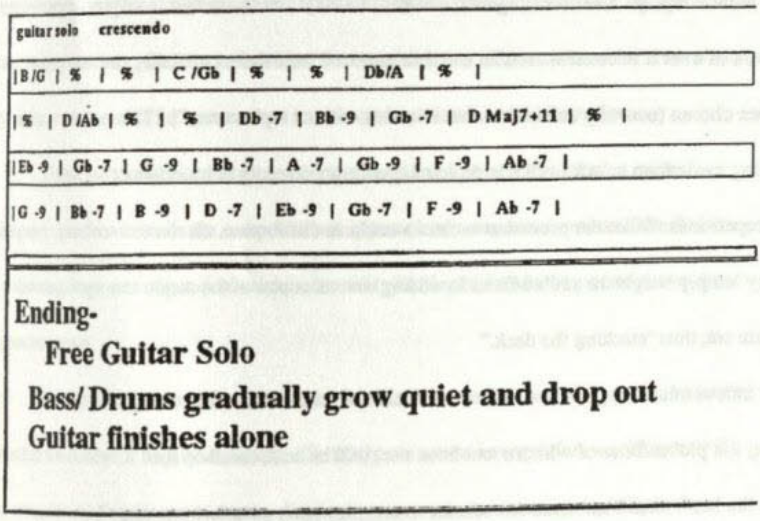


Figure 5.8. *Transitions* demo

reading" from the interface in performance. While each screen could be individually prepared, their selection and ordering was unknown to all in performance.

Figure 5.8. The last two screens in this short example are another set of computer generated chords for a guitar solo, and the selection of an ending texture.

Event Progressions

One issue addressed by *Transitions* was the construction of "event progressions." This concept was used both in the construction of standard chord progressions, and in the connections of other media events: graphics, notation and text. Two main approaches to the indeterminant selection and ordering of performance materials were employed. The first

was based on the MINC "spray" function integrated into Paul Lansky's *cmix*. In this function, an element of a set is selected at random and then removed from the set until all members have been chosen (normally called "random selection without replacement"). This is similar to drawing cards from a deck until it is depleted, creating a diversity of materials without obvious repetitions. Since the procedure creates a uniform distribution, the composer can very simply weight the probabilities by adding several copies of the same element to the main set, thus "stacking the deck."

The other indeterminant approach was the construction of "second order transition tables," describing the probabilities of which event from a set will be next, based on the current event and the last event. I had used this scheme to organize pitch material in several previous tape compositions. It serves to create a greater coherence from event to event but lacks any large-scale organization.

In a performance of *Transitions*, these two indeterminant methods, and the conductor's personal choice, are coordinated in the selection of events. This allows easy automated sequences of similar materials, and instantaneous texture changes.

Analysis

This meta-compositional interface incorporates two methods for autonomous action in the realization of musical structure. First, the construction of event progressions from markov chains and chance operations allows the computer to independently determine musical features in performance. Second, by manipulating established symbols for jazz

improvisation, graphical scores and text cues, the improvisational performers are also being used as spontaneous generators of musical form and content. This combination creates new dynamic environments for spontaneous human communication and interaction.

Using technology to design a musical score as a multimedia document within a computer interface extends the compositional approach of composers such as Earle Brown by allowing huge sets of pre-determined material to be flexibly recombined and manipulated in performance.

The most common audience reaction was to ask what the role the computer had, and whether we needed it to play as we did. Certainly we would have performed differently if we were not reading from a computer display, however, there is a unique quality to the resulting performances which goes beyond that. In recordings done with the interface there are more spontaneous swells, abrupt textural changes, and clear yet irregular phrase shapes than in other "free" improvisations by the group which tend to have longer, "flatter" textural sections. The interface provides a common shape and textural aim for the group. Without it we would have had to plan sudden shifts in some fixed way, or have uncommon intuition.

For the players, the preparation to perform Transitions posed unique problems. We each received copies of the graphical information as it was composed, and practiced the individual units as separate compositions. The spontaneously composed chord progressions were more difficult. As I developed the algorithms for these sections I would bring example printouts to the ensemble to allow us to get a feel for the progressions. Still, when

confronted with a new progression, it took the group several tries to feel comfortable improvising within it. Only after about a month of rehearsals were we able to effortlessly play from spontaneously composed structures. It was as though we had to intuitively learn all the relationships possible within the meta-composition in order to freely navigate (as opposed to learning one set of relationships in a standard jazz form).

As a composer/conductor, the interface created another new experience. There was an interesting control over structure, timing, and musical freedom which I could exercise during the course of the performance. On some levels our performance could have been directed with hand signals and gestures. But, the potential amount of information conveyed, its specificity, and the number of participants that could participate, makes the development of dynamic performance interfaces a promising area of study.

As a jazz performer, the interface allowed me to extend my existing improvisational skills into a new large-scale through-composed form. The experience of performing *Transitions* differed from other situations I have experienced with attempts to extend jazz forms in that the spirit of improvisation was not sacrificed in the pursuit of musical organization. We were navigating a musical terrain where we were never sure which way the piece would turn. This spirit of group exploration is a large part of the essence of improvised music.

Conclusion

The performance interface for *Transitions* accomplished some basic goals I set for

myself as a first step towards building a meta-compositional computer interface for real-time performance coordination. In order to explore the full potential of such a medium, much larger sets of information would have to be constructed. Ideally, an interface such as this could incorporate the total repertoire of an ensemble. A night's performance could be spontaneously shaped drawing from many sets of possibilities. The composer(s) could easily edit or add new information for each performance and the meta-compositional structure would grow and evolve along with the ensemble. The possibilities of the material would be fully appreciated (by both listeners and players) only after several performances.

New technology allows musical notation to be a fluid medium incorporating both traditional notions of musical structure, and concepts drawn from computer-aided composition. Most of the potentials of the media involve interactive changes in the direction, flow or content of a composition. Since these structural changes create an unknown outcome, improvisational skills become a necessary tool in the realization of the musical composition. Even with strictly notated materials, the ability to flow and adapt to a spontaneously changing environment is paramount.

This application of technology uses the computer to create new environments for human interaction. It draws upon established musical behaviors, casting them into new contexts where additional flexibility in the communication between performers allows a more dynamic structuring of group interaction.

Chapter Six

Prelude

CD I, *Compositions*, Index 4: *Prelude* (Princeton University, Taplan Auditorium 5/14/96)
Curtis Bahn, String-Bass

Prelude is an interactive meta-composition for improvisor and recorded sounds on computer disk. It was the first performance structure that I designed after changing computer platforms from NeXT, to a portable Macintosh 5300ce Powerbook. My goals in this work were to create a high-level dynamic interface which allowed me to cue and mix pre-composed sonic materials in performance, and to establish a rudimentary system for cuing a performer about the nature of sound-resources chosen by the interface. Finally, the structure had to be simple enough to allow me to "drive" it while I performed on my instrument.

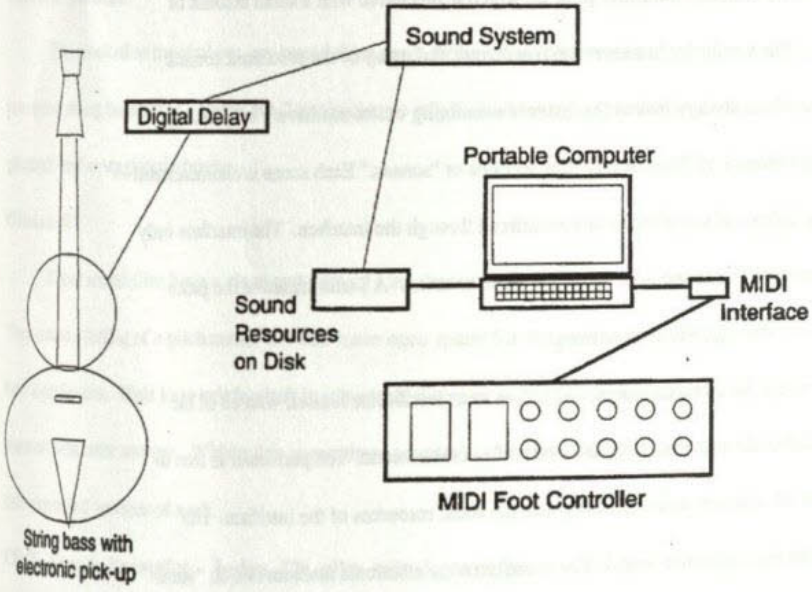


Figure 6.1. *Prelude* Technical Set-up

Technical Notes

Figure 6.1 shows the technical set-up for a performance of *Prelude*. A MIDI foot-controller sends messages to an interface running on a portable computer allowing the performer to choose and mix from sets of pre-composed sound-files on disk. The interface was programmed in the Director 5 multi-media development environment using Lingo, a high-level scripting language.[73] In the performance of *Prelude* presented in this chapter, I

[73] An example of a Lingo script used for Prelude is included as Appendix III.

play a string-bass with an electronic pick-up which is processed with a small amount of digital delay. The similarity between the live sound, and many of the processed sounds within the interface, always leaves the listener wondering where sounds are originating.

A performance of Prelude has four sections or "scenes." Each scene is characterized by a different palette of sound-file choices offered through the interface. The interface only allows the performer to move forward from scene to scene. A performance of the piece consists of a trip through the four scenes.

To prepare for a performance, the player must familiarize himself with all of the sound-files within the interface and their possible combinations. The performer is free to play whatever he chooses while he navigates the sonic resources of the interface. His familiarity with the electronic sound-files transforms the electronic medium into an "aural score."

***Prelude*, Scene 1**

While the exact form of a sound scene is indeterminate, each has a clear character. Following are two realizations of the computer part without live performer for scene 1:

CD II, *Sound Examples*, Index 20: *Prelude*, Scene 1 ex. 1 (duration 5:05)

CD II, *Sound Examples*, Index 21: *Prelude*, Scene 1 ex. 2 (duration 5:28)

The "Players"

The cast of players within this scene can easily be drawn from these examples. There are three general categories: plucked strings, percussive rolls, and sustained noise.

Plucked Strings

The plucked string timbres are sound-files made from mixes of natural and processed string bass tones. There are 2 basic classes of plucked strings in the scene: glissandi and arpeggiated chords.

Glissandi

These sound-files have a clear and present tone drawn from artificial harmonics. They create a feeling of a pitch center but still leave open space for the performer to define their significance. Their long subtle pitch bends create distance and depth when played alone or with other sources. Within this scene there are two basic glissando mixes, and time-expanded versions of each.

CD II, *Sound Examples,* **Index 22: gliss mix 1, excerpt**

This sound-file is very sparse, the close microphone placement of the recording enables a very present sound with an unusually long decay.

CD II, *Sound Examples,* **Index 23: gliss mix time-expansion 1, excerpt**

The phase vocoder time-expansion gliss mix 1 gives the sound of shifts and string articulations a "breathy," surreal quality which can be heard throughout the scene blending into the other noise sources.

CD II, *Sound Examples,* **Index 24: gliss mix 2, excerpt**

Gliss mix 1 is combined with transpositions of itself to make a slightly more dense sound-file.

CD II, *Sound Examples*, Index 25: gliss mix time-expansion 2, excerpt

An irregular phase vocoder time-expansion of the previous example.

These sound elements can be heard individually or mixed within this scene. The possibility of cross-fading between natural and processed versions of a sound is a basic technique of the composition.

CD II, *Sound Examples*, Index 26: gliss cross-fade from Scene 1, ex. 2, (index 21)

At the start of this example there is a time-expanded glissando mix in the foreground; a distant unexpanded mix enters, cross-fades with the stretched version and is ultimately left sounding alone.

Arpeggiated Harmonic Chords

The arpeggiated harmonic chord mixes are made from natural string bass tones and harmonics. They repeat a four or five note sequence at irregular intervals. As with the glissandi,there are also time-expansions of each basic mix.

CD II, *Sound Examples*, Index 27: harmonic mix 1, excerpt

Harmonic mix 1 arpeggiates a four note chord at irregular intervals. It could imply the sonority $E7^{\flat 9}$.

CD II, *Sound Examples*, Index 28: harmonic mix time-expansion 1, excerpt

An irregular phase vocoder time-expansion of the previous example.

CD II, *Sound Examples*, Index 29: harmonic mix 2, excerpt

This excerpt arpeggiates five notes at irregular intervals. It could imply the sonority E7#9.

CD II, *Sound Examples,* **Index 30: harmonic mix time-expansion 2, excerpt**
An irregular phase vocoder time-expansion of the previous example.

When used within the context of the scene, these files can create a sense of harmonic support. They provide forward motion while leaving the articulation of meter undefined. The quality of their sound is such that a solo string bass can still be easily heard through the sonority.

As with the glissandi, musical effects are created by cross-fading between natural and processed versions of the mixes.

CD II, *Sound Examples,* **Index 31: harmonic mix cross fade from Scene 1, ex. 1, (Index 20)**

Harmonic time-expansion 1 fades out as harmonic mix 2, then harmonic mix 1, fades in.

Rolling Percussive Sounds

Three 60" sound-files of percussive sounds are found in this scene. The sounds are drawn from taps on the body of a string bass that have been algorithmically mixed and spatialized. Several versions of very similar mixes are included so that exposed articulations of the sound-files will not become recognizable.

CD II, *Sound Examples,* **Index 32: roll mix 1, excerpt**

CD II, *Sound Examples,* **Index 33: roll mix 2, excerpt**

CD II, *Sound Examples,* **Index 34: roll mix 3, excerpt**

Noise Sources

There are three noise sources within the scene. The first two are drawn from phase vocoder time-expansions of the rolling percussive sounds. The third is a time-expansion of a string bass, *sul ponticello* gesture.

CD II, *Sound Examples*, Index 35: low noise, excerpt

An irregular time-expansion of a portion of sound example index 34.

CD II, *Sound Examples*, Index 36: high noise, excerpt

Sound Example 35 convolved with a burst of white noise, channels reversed.

CD II, *Sound Examples*, Index 37: pitched noise, excerpt

An irregular time-expansion of a string bass *sul ponticello* gesture.

The noise sources provide a sort of sonic glue that helps mask the "volume knob effect" caused by fading files in and out. They provide distance and space, helping to create the sonic environment. Fading between noises with different characteristics helps to vary the quality and size of the space.

CD II, *Sound Examples*, Index 38: noise cross-fade from Scene 1, ex. 1, (index 20)

In this example low noise fades to pitched noise setting up an entrance of the harmonic chords.

Scene Construction

Each scene provides the player with eight sets of sound-files assigned to buttons on

the MIDI footpedal.

An example of a sound set from the first scene is the set of all percussive rolls. Each time a roll is requested, a different version will start. After the sound is finished, the sound set will continue to cycle through all its members until stopped by another button press.

Sound sets which have interesting relationships are positioned opposite each other on the two MIDI faders. In the first scene, the harmonic mixes are placed opposite their time-expanded partners allowing cross-fade effects such as those heard in the examples at indices 26, 31, and 38.

Figure 6.2 shows the performance screen for the first scene of *Prelude*. The sound-file sets and their assignments to the MIDI faders are indicated.

The Performance

CD II, *Sound Examples*, Index 39: *Prelude* performance, Scene 1.
Curtis Bahn, String Bass

Listen again to the first scene from the full performance. Figure 6.3 presents a graphic view of the sonic material used in the scene. In most cases the live string bass plays material drawn from, or complimentary to, the composed sound-files. Through familiarity with the composed materials, the improvisor can anticipate and seemingly lead the sounds on disk. This keeps the listener wondering where the sounds are coming from, and whether the electronic textures are created somehow from the material that was just played. The interface's random selection of sound sources creates unexpected combinations of sounds which helps

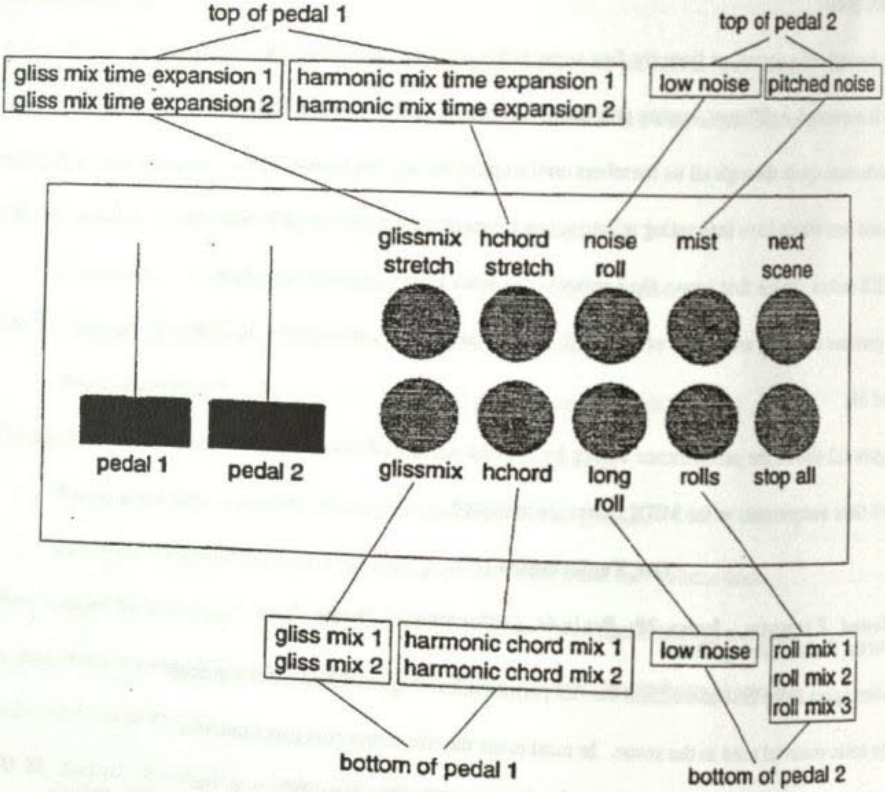
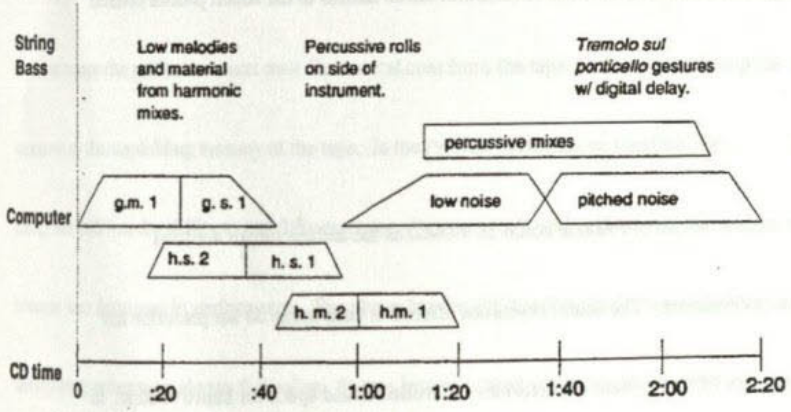


Figure 6.2 ***Prelude*** **Soundfile Sets and Assignments, Scene I**



g.m. = gliss mix
g.s. = gliss stretch
h.m. = harmonic mix
h.s. = harmonic stretch

Figure 6.3 *Prelude* Performance - Scene 1

keep the environment interesting for the improvisor.

The sound sources in the remaining scenes are coordinated in the same way as the first scene. As the performer progresses from scene to scene, the textures become progressively fuller and more percussive. In each new scene, a few sounds are retained from the previous

scene and a palette of new ones added. The fourth scene returns to the sound palette offered in the first.

Analysis

The meta-structure of *Prelude* could be viewed as the architecture of a virtual performance environment. The sound resources offered in each scene do not prescribe any action, rather, they offer a dynamic, performer-controlled sound space for improvisation. In this work, there is no notated score; the sound-files and the interface itself act as a direct articulation of the organizational structure. The initial preparation for performance involves learning all of the sounds resources *by ear*. This is necessary in order to improvise both by mixing and traversing the composed sounds, and in developing the spontaneous voice of the performer within the sound space. As with *transitions*, the work combines autonomous actions by the computer and the performer.

From the point of view of electro-acoustic music composition, this approach to integrating live performance and composed sounds offers great flexibility . In performances

for "tape and," the most awkward moments often come at the beginnings and ends of phrases. In most cases the performer must wait for musical cues from the tape, always surrendering the moment to the unyielding tyranny of the tape. In the *Prelude* performance interface, the composer still has the ability to carefully compose electronic textures but these textures become less dominant in performance. The player has the ability to musically cue phrases, anticipating rather than always following. Spaces between taped entrances can be more responsive to the performance, and the ends of gestures can be tapered to the moment rather than an approximation made in the studio.

The ability to reorder and mix sound sources during performance changes the musical activities and relationships of both the composer and the performer. The sound space becomes much more flexible and permutable, but the composer loses considerable control of the compositional structure of the performance. The act of composition becomes similar to the design of a hypertext document. In this activity, the composer creates the limits of the sonic world and the performer navigates a trip through it. The result is a collaborative effort which

challenges traditional notions of authorship, and composer/ performer relationships.

The performer, while given considerably more freedom than in traditionally notated music, still is bound by unyielding musical phrases. In *Prelude* the only affect that the performer can exert on the individual computer sounds are changes in amplitude, onset and finish. These are formidable controls in ordering and shaping the music, but the resulting landscape is still considerably less dynamic than a purely improvisational one. While the entire interface could be categorized as one for "interactive performance," the nature of any man/machine interaction is extremely limited and rudimentary.

This relationship is not necessarily a bad one. It presents a world of musical possibilities which is based on a collection of known quantities. A player can prepare for a performance by studying the precomposed textures and sound palettes for each scene as he may study a musical score. He can devise certain pathways that he feels are successful. Once the basic materials are assimilated the question "what else can I do with these sources," becomes the driving force to more successful and adventuresome performances.

Prelude presents a musical world that can be known and explored in performance. One criticism that I have had in constructing hypermedia interfaces to musical structures is the notion that performers like to know what will happen in a piece so that they can prepare and pace their performance. While in *Prelude* this preparation is still present, it now becomes more multi-dimensional. One must prepare for not only the individual musical materials but their juxtaposition, and the difference in affect of different orderings, relative volume levels and pacings.

Chapter Seven

Quartet Improvisations

CD II, *Sound Examples,* Index 40, excerpt from improvisation.
Bob Ward, Guitar
Dan Trueman, Electric Violin
Satoshi Takeishi, Percussion
Curtis Bahn, Bass/ Sound-files/ Processing

This chapter examines the development of the *Prelude* performance interface into a more general interface for coordinating an ensemble. My goals for this phase were to: 1)

combine the sound-file mixing capabilities of *Prelude*, with the hypertext score generation of *Transitions*, and 2) to introduce MIDI control and coordination of external sound processors. As with transitions, I felt that it was important to develop and explore the musical possibilities of the interface within the context of a group. In this way, new musical elements could be integrated gradually, allowing a process of transformation and growth to take place within the ensemble, and in our use of technology. I was fortunate to find three other musicians who felt similarly, and were willing to meet regularly specifically to explore the musical possibilities of the performance interface. These musicians were: Guitarist Bob Ward, Electric Violinist Dan Trueman, and percussionist Satoshi Takeishi. The musical examples in this chapter are based on recordings made by this group during a six month period from September 1996 to February 1997 .

Performance Concept

The quartet integrates improvisation and composition in several forms: traditional notation, graphic notation, text cues, electronic sounds on disk, combinations of signal processing routines, and verbal directions. A major aspect of every performance is the ensemble's free improvisation. At any time, the performer acting as conductor can use the computer interface to introduce various composed media into the performance. Scores and cues for the players are displayed on video screens which are positioned in front of each performer like conventional music stands. Some of the scores demand a synchronized group effort in performance, other musical material may be very abstract, creating a common musical

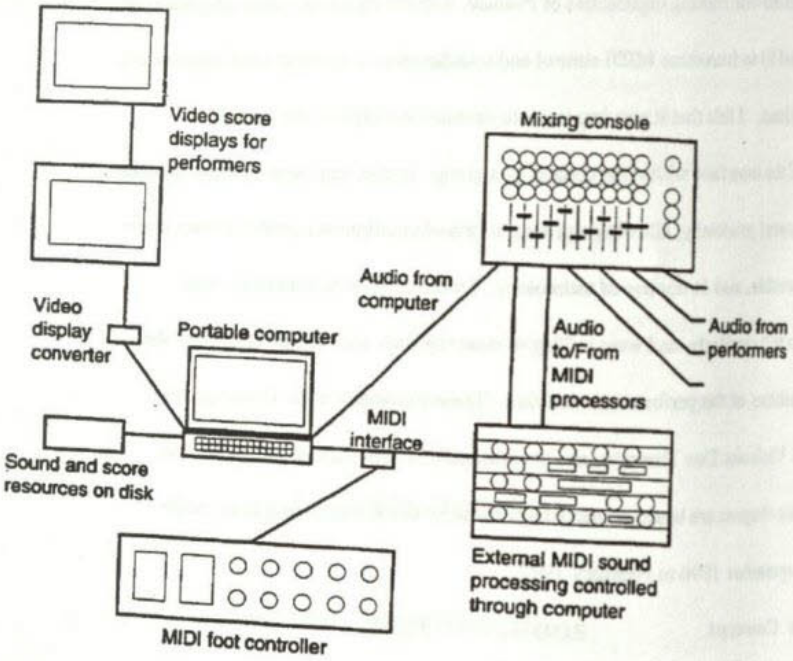


Figure 7.1 Performance Set-Up

stimulus for the performers while not being prescriptive of any particular action. The screens also communicate what the computer is doing at the time, such as playing a particular sound-file, or recording the ensemble for later processing.

Preparation for a performance includes: practicing traditionally notated ensemble passages, discussing and practicing approaches to more abstract material, and studying the sound-files accessible through the interface until they are familiar and function as an aural

"score."

Set-up

Figure 7.1 shows the basic technical set-up for the quartet. Priority was placed on developing an affordable, portable and robust configuration which could be used in a variety of different performance contexts. The core of the configuration is the same as that for *Prelude:* a portable computer, sounds stored on an external disk drive, and a MIDI foot-controller. Two other branches are added to the new set-up; video display, and sound processing. The interface is written in Lingo for Director 5.[74]

A video display converter is attached to the computer, changing the monitor output into a signal that can be shown on any television set. This reduces the quality of the picture greatly, but at the time it was the only affordable solution to creating an inexpensive system with any number of screens. If another member joins the band he basically brings his horn and his T.V., and we're ready to play.

All of the members of the ensemble send their audio outputs to a portable mixer where they are routed to a number of MIDI controlled digital signal processing devices coordinated through the performance interface. Using external signal processing frees the interface from computationally expensive tasks, as well as creating a robust, inexpensive and modular configuration which can evolve with the ensemble's needs.

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74 The Lingo routines referred to in this chapter are very similar to those used in *Prelude*. Refer to Appendix III for an example of a Lingo script.

I have been using two basic types of MIDI devices; dedicated recording and looping machines, and "effects processors." In the examples presented in this essay I have three looping devices with the ability to record a total of six minutes of high-quality digital audio. Each device is slightly different, but all can replay recorded audio forwards or backwards, once or looped. Sound can be overdubbed on the recordings, creating a dramatic layering technique we came to call an "accumulation." I also used two "effect processors," capable of simulating reverberation, creating small delay loops, changing the pitch of a signal, and a number of other common sonic transformations. The portable mixer allows different signal routings and processing for the members of the group. In addition to my equipment, each member had his own personal "arsenal" of effect processors, which he controlled manually before sending his signal to the main mixer.

Interface Design

Figure 7.2 shows a schematic of the musical environment within the performance interface. There are two major branches; score selection, and sound selection. There is also an area which allows MIDI effect parameters to be assigned to external processors. Using the MIDI foot-controller this space can be traversed, selecting and combining options dynamically. The functions available on the foot-pedal change throughout a performance, and are displayed graphically at all times.

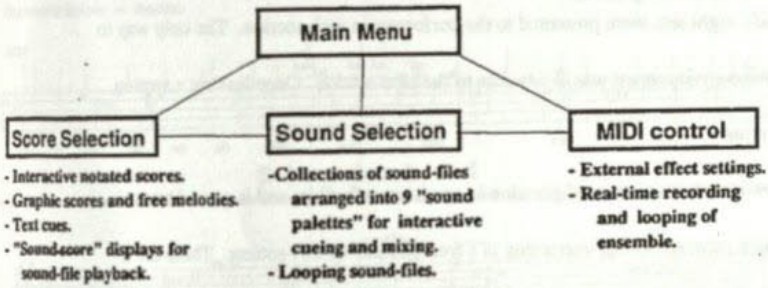

Figure 7.2 Performance Environment

Main Menu

Upon launching the interface, the user is given a choice of moving to the score selection area or one of ten different collections of sound-files within the sound selection area.

Sound Selection Pages

The ten sound selection areas each contain a unique collection of sounds arranged into four sets, each set representing a different sonic texture. The sounds within these sets are accessed through the MIDI foot-controller, when a set is selected the interface chooses a member sound-file and begins playback. The interface will continue to cycle through the members of the sound set at random until playback is stopped by the user. A MIDI continuous controller allows the sounds to be mixed, and their levels to be adjusted in performance.

The approach to sound selection for the quartet is very similar to that used in *Prelude*,

however, a smaller group of textural sound sets is presented to the performer at any given time. In *Prelude*, eight sets were presented to the performer in each section. The only way to change your sound environment was to advance to the next section. Once leaving a section, one could not return.

The new sound selection configuration is much more flexible, and is geared towards presenting a more general tool for interacting in a freely improvisatory setting. There are a greater number of sound selection screens overall, but each presents fewer textural sets. All areas of the performance environment can be traversed freely at any time.

Other options and controls for a sound selection page include: a second continuous controller assigned to dynamic MIDI performance parameters; three buttons dedicated to controlling real-time recording and looping devices, a button leading to the main dsp page, a button leading to the score display area of the interface, a button returning to the main menu , and a "panic button" that stops and resets all sounds and external devices.

Sound Scores

Up to three stereo sound-files can be played at one time by the notebook computer before introducing the possibility of clicks, or extreme latency. As a sound-file plays, a score is shown on the video display. Figure 7.3 gives an example of the main sound-file performance display. Here we see three sound-files playing simultaneously, the scores show transcriptions or graphical representations of these files. The vertical axis does not represent correspondence between the sound-files, as the sounds may have been started at very different

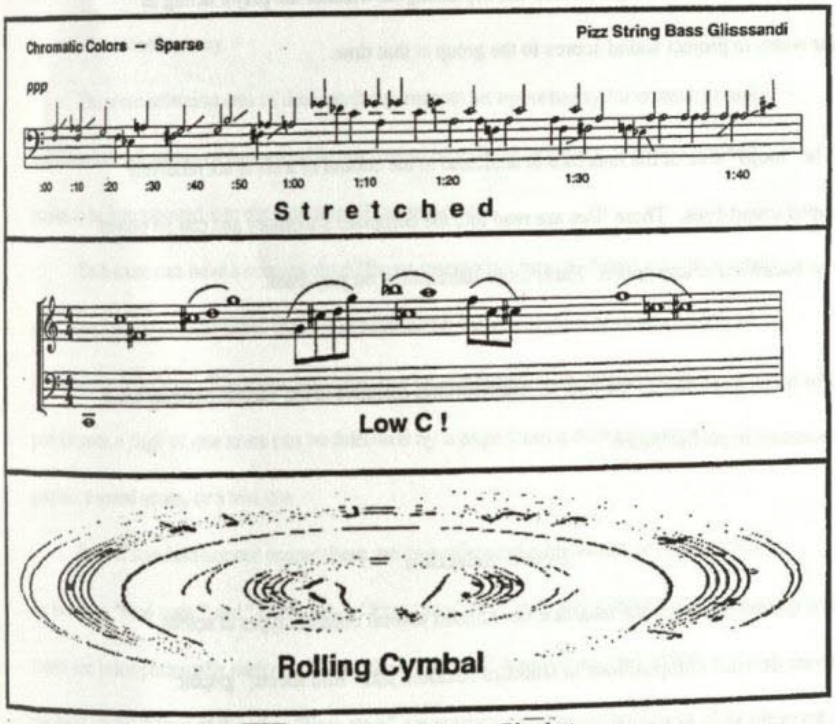

Figure 7.2 Sound Score Display

times. Depending on the real-time mix, certain elements on the screen may not be audible.

In performance, sound-files are mixed in various ways to create environments for group improvisation. The players, having experience with the sound-files, use the visual images as a memory aid, allowing them to interact with the sounds and anticipate events on the tape. The scores are descriptive rather than prescriptive, helping to develop the group's common knowledge of the musical context in performance.

This feature can be turned on and off, depending on whether the player acting as conductor wants to project sound scores to the group at that time.

Loops

The "loops" area of the interface is dedicated to the control of a set of six relatively short, looped sound-files. These files are read into the computer's memory and can be played forward or backward at any speed. Each loops indefinitely on play-back.

MIDI

The MIDI page allows the user to select settings assigned to the various external MIDI effect processors in performance.

Score Selection

The quartet performance interface coordinates several different types of scores ranging from: detailed compositions in standard notation, jazz "lead sheets," graphic scores,to text cues such as were used in *Transitions*. These materials can be accessed at any time, in any order. The ensemble's reaction to a given score or cue varies depending on the cue and the current activities of the group in performance. In performance, the scores and cues are considered end-points for the current section of an improvisation; not as immediate cues, but as long range "goals." The conception of real-time score generation as providing goals, rather than specifying immediate action, allows more freedom for the improvisational performers while still lending shape and textural variation to the music. As

with *Transitions*, the musical challenge is to navigate from the current texture to the next in a musically interesting way.

The score selection area of the interface presents an opportunity for compositional collaboration. Members of the ensemble are free to contribute graphics, text, and notated scores to be incorporated into the structure of the interface.

Each score can have a completely different interactive aspect. Some are just a single page, some include several pages which are sequenced with a mixture of determinate and indeterminate orderings. The scores and cues can be combined with each other in performance, a page of one score can be followed by a page from a different score, a graphic, a sound score, or a text cue.

Besides standard notated scores there are two other general classes of scores within the interface: "Free cues," and "Text cues." "Free cues" are randomly selected graphical scores and heterophonically performed melodies. Figure 7.4 shows several of the graphical scores. Many of the other "Free cues" are rotations and transformations of these examples. Abstract graphic scores do not prescribe any particular actions, but serve to provide a common stimulus in performance. The interpretation of the graphic symbols varies as they are contextualized in performance.

"Text cues" are randomly selected short performance directions. These cues can

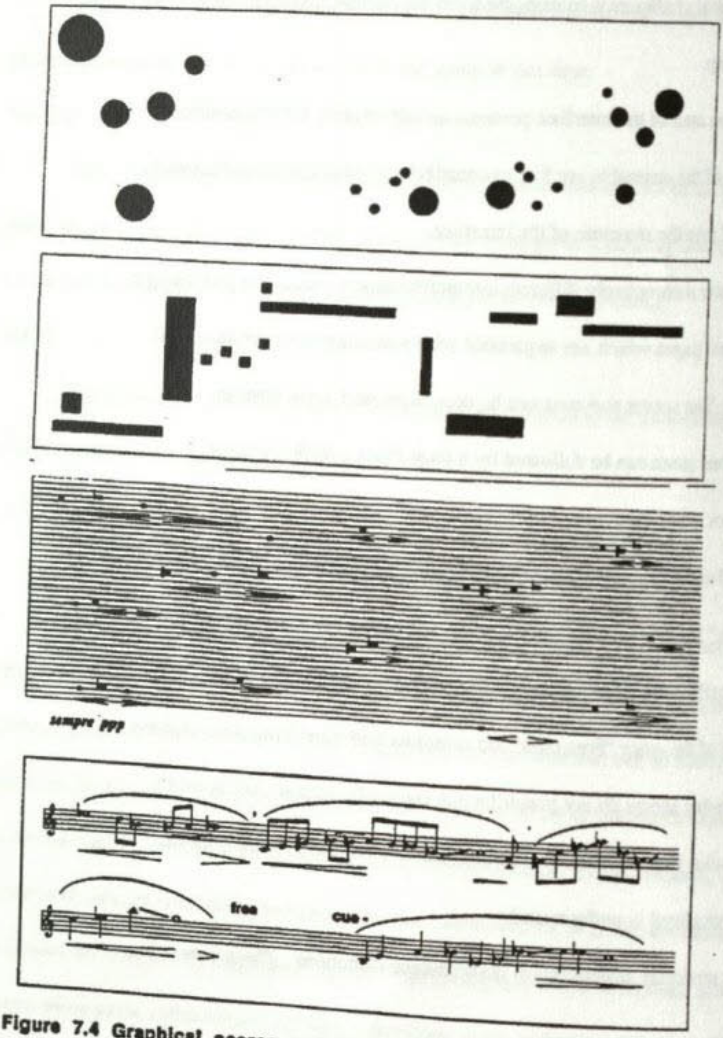

Figure 7.4 Graphical scores and heterophonically performed melodies

```
make a loop of some length and continue looping it, phasing with others
dense composite texture
thin composite texture
thick sound mass
thin quiet sound mass
Thin the texture
play a slow tempo
play a very slow tempo
play a medium tempo
microscopic sounds
machine
gamelon
follow crb
follow dan
follow bob
follow satoshi
follow crb - ppp
follow dan - ppp
follow bob - ppp
play conversational exchanges
extremely quiet, thin, high and sustained
extremely quiet, thin, low and sustained
sparse and pointalistic
play gestures that start slow and speed up - phrased together
play gestures that start slow and speed up - out of phase
play in ensemble gestures that speed up and slow down
follow dan's bow for gestural shapes
play free independant melodies  - any key
satoshi set tempo
satoshi alone
bob alone
crb alone
thin to duos
thin to trios
dan alone
quickly exchange short solos
satoshi speed up and slow down, others follow
dan conduct with gestures
satoshi conduct with gestures
start electronics accumulation
rapid panning
Ascending "wrong note" scales
Descending "wrong note" scales
quiet long high tones on dan's cue
quiet low tones on dan's que
complete texture change on dan's cue
start or stop tempo on dan's conducting
```

Figure 7.5 Examples of Text Cues

take the form of solo or sub-group assignments within the ensemble, gestural control, textural suggestions, or standard musical terms. Figure 7.5 lists a number of possible text cues. This technique turned out to be a very successful aspect of the interface. The text cues could easily be updated before a performance to add a new idea or to integrate a new player into the interface.

In performance, the performer acting as conductor can select to display the graphic sound-scores relating to sound-file playback, (as discussed under "Sound Selection" above) or, to display notated scores and cues from the group.

Tracing Threads - *Vocable Vamp*

Many of the sound-files present in the interface are textures drawn from my previous tape compositions. One such set of textures is derived from, *Vocable Vamp* (1991), a computer music fantasy based on the sound of jazz drummer Ron Vincent's Voice.

CD II, *Sound Examples*, Index 41:*Vocable Vamp* (1991), excerpt

I excerpted sections from *Vocable Vamp*, and divided them into four sets; sparse textures from the opening, crashes, active vocal textures from the middle of the piece, and the long ending crescendo. One excerpt is placed into the sound looping page allowing me to change its pitch and play it either forward or backward. The remaining excepts were organized into a textural palette for a sound selection page. Since the *Vocable Vamp* is strongly evocative, yet lacks a clear sense of meter, it has successfully found its way into a

number of different musical situations. These examples will not only illustrate the use of sound-files in improvisatory situations, but also demonstrate more of the group's signal processing and looping vocabulary.

CD II, *Sound Examples*, Index 42:*Vocable Vamp* mix excerpt 1 (1/6/97)

Beneath a sparse violin solo using the "wa-wa" pedal, sounds from the "crash" texture set play. The percussionist holds a steady beat with brushes, adding random accents along with the voice. The bass plays high punctuating chords.

CD II, *Sound Examples*, Index 43:*Vocable Vamp* mix excerpt 2 (11/21/96)

In this excerpt, I vary a footpedal speeding up and slowing down a sampled vocal loop. The violin plays low *sul ponticello* tones, manually panning his sound with another footpedal. Towards the end of the excerpt several other loops of the violin sound softly and start to emerge and pan.

CD II, *Sound Examples*, Index 44:*Vocable Vamp* mix excerpt 3 (12/26/96)

This excerpt starts with the percussionist playing "talking drum." He is sampled while he plays and his sound is looped forward in one ear and backward in another. The vocal sounds fade-in quietly mixing with the low drum tones.

CD II, *Sound Examples*, Index 45:*Vocable Vamp* mix excerpt 4 (1/20/97)

A louder example. The bass play low tones with distortion while the violin and guitar take raucous high rock-and-roll solos. The percussionist blends with active vocal lines taken from the middle of *Vocable Vamp*. Towards the end of the excerpt, I fade to crashing

vocal sounds on the computer and begin a low bass figure. The percussionist matches the tape sounds by playing on his crash cymbal.

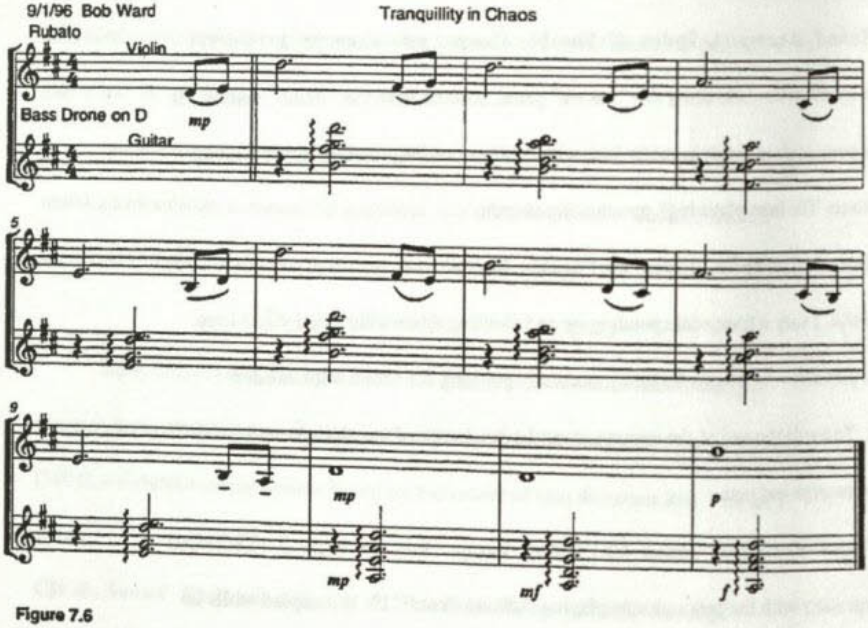

Figure 7.6

Tranquillity in Chaos

Threads of notated music also intertwine with improvisation, and sounds on disk. The interface allows an ensemble to collaborate in the composition of these materials and musical fragments which make up the meta-compositional framework. The opening

excerpt highlights a melody written by Bob Ward entitled, "Tranquillity in Chaos" (Figure 7.6). In the course of our development this melody became a vehicle of transformation; its simple clear form allowed us to first begin exploring some of the many other performance possibilities offered by the interface.

CD II, *Sound Examples*, Index 46:*Tranquillity in Chaos* excerpt 1 (9/19)

This excerpt is drawn from one of our first rehearsals of the tune. We take only standard liberties, as one would take with a jazz "lead-sheet." The violinist embellishes the melody, we all move with his interpretation.

CD II, *Sound Examples*, Index 47:*Tranquillity in Chaos* excerpt 2 (11/24)

As I loop a low bass drone and drum on my bass, I am mixing precomposed sound-files of arco string-bass chords chosen at random by the interface.

CD II, *Sound Examples*, Index 48:*Tranquillity in Chaos* excerpt 3 (1/20)

In this excerpt the violinist plays the melody through a "harmonizer," I play low *sul ponticello* bass tones with reverberation, cuing sound-files drawn from my composition "*Nightmare*." As the violin repeats the melody I begin to softly fade in samples of lines he played in the previous section of the piece. After the second repeat there is a short "coda" composed of several out-of-phase loops of violin melody.

Listen again to the sound example from the beginning of the chapter: CD II, *Sound Examples*, Index 40. This example starts with drumming, *col-legno* violin, and recorded sounds of cymbals spatialized with a binaural filter. The drumming breaks down, and we

are left with only the sound of rapidly panning segments of sampled drum loops. At about this point (about one minute into the example) the ensemble was cued to play "*Tranquillity in Chaos*." I begin to drone on a pizzicato low D, ultimately sampling myself and playing the rhythmic line backwards under the ensemble. The violin and bass begin to bow together starting a long "accumulation," building for several minutes. Fading the accumulation, I start a long gliss down to a low D pedal tone. The low tone is sampled and sustained under the group. As the violin begins the melody, I fade in pre-composed sounds of string chords and play pizzicato counter lines. After the second repetition of the melody, quiet loops (forward and reverse) of the ensemble are faded and panned. The ending sounds are the sampled string-bass drone played down an octave. Note that from the time of the cue for "*Tranquillity,*" there is a coordinated gesture of nearly five minutes leading to the start of the melody. This is a clear example of how a score cues can represent the end-point or goal for improvisation.

Analysis

This interface coordinates the process-oriented representation of music in many ways including graphical scores, indeterminate notation, prose, and composed sound-files with descriptive graphical scores. The actions of the "conductor," the player "driving" the interface can trigger determinate, or indeterminate sequences from the computer. In addition to composed and programmed resources, the music was a result of collaboration and discussion within the ensemble over a period of time, developing a group approach to

the stimulus of the interface and performance in general. In this way the meta-composition successfully integrates technology with oral transmission, aural transmission (both in playing and the learning of sound-files), determinate and indeterminate musical notation. The extent of the meta-composition is the sum total of the material and the ability to transform, reorder and combine it.

Conclusion

The generality of the performance interface for the quartet begs the question: "Is this a composition or a tool?" Many aspects of the interface do function as a sophisticated performance tool. The MIDI implementation in particular merely provides a simple method for the task of changing presets on various external devices. The sound-file playback and mixing capabilities automate sequences of music and allow a simple level control apparatus. Score display facilitates communication between the performers and helps eliminate the "shuffle" of players searching for sheets of music during a performance.

Beyond these conveniences, several things separate the final quartet performance interface from a simple tool. First, the sum total of musical material present in the structure: composed sound-files, notation, graphics, text, dsp settings, real-time processes etc. Second, the encoding of specific processes and behaviors into the computer interface: the ways that sound-files or scores are selected, the ways that the interface acts under specific conditions, the ways that sounds fade, the ways that material can be combined. In this way, the sum total of the musical material, and the behaviors encoded in the interface

become the scope of the meta-composition.

The interaction of technology and human interaction along with a highly collaborative setting has made this by far the most rewarding musical activity presented. The interface moved the group in new directions, and the members involved each other in musical ways with a result that none of us could have anticipated. I feel as Larry Austin did when he described his interaction with the "New Music Ensemble" during the '60s:

> Our group has grown and matured so much that we find that what we do as a group in certain areas is equal to, if not greater than what an individual can do in a "brain storming" session with himself. I accept the group's creativity as a legitimate area of my work as a composer. I feel the need for group synergy and feel I can profit from the involvement.[75]

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75 Larry Austin, from "Groups" (*Source* 3/1, 1968), 15.

Chapter Eight

Conclusion

The Social Context of Computer Music

The historical shift from multi-user facilities to personal computers has greatly impacted the social context of computer music composition. Institutional multi-user systems supported a community of composers who were forced by necessity to develop new musical works in public. While this may not have always been ideal, it did create a unique opportunity to observe and learn from the working process of others. What other situation in musical history could have brought a room full of composers together, shoulder-to-shoulder, day after day, each taking turns playing sketches of over a single pair

of loud-speakers.

With the advent of powerful home-computers, many composers left the public studio and returned to a private development process. As institutional computer music studios began to decline, a significant aspect of creative exchange in the field was lost. Composers can now communicate through recordings, the internet, special interest mail lists, and streaming audio world-wide-web pages, however, this extended virtual community does not have the direct, unedited exchange that once was the multi-user facility.

Another significant change in the social context of computer music is seen in the movement from desk-top, to mobile computing facilities. Portable technology allows the facilities of the composer's studio to be easily trasnported into conventional musical situations such as rehearsals, and performances. This allows an organic integration of technology and established social musical processes that was very difficult, or impossible, with more cumbersome equipment.

My work presented in this essay outlines a personal shift from the use of multi-user to personal computing facilities, and, the development of a portable computer music system. I found that the ability to take a computer into regular rehearsals was one of the most enlightening aspects of developing a performance system. The unexpected musical happenings that arose from this process were fascinating, and invaluable to my musical development. I feel that this sort of simple integration of technology and performance will

mark a significant change in the technology of musical communication and the cultural context of computer music. The musical exchange between composers that was lost with the decline of muliti-user systems is more than compensated for in the ability to re-join the musical community through mobile computing.

Modelling Musical Interaction

"Interactive computer music systems," are, according to Robert Rowe, "those whose behavior changes in response to musical input."[76] Inherent in Rowe's view are complex issues of computer science, relating to concepts such as "machine musicianship." Several of the works examined in his book aim to construct systems which evaluate "musical input" by "emulating human musical understanding." Rowe writes of the goal of "programming a computer to exhibit human-like musical aptitude," stating that this approach will have a broad range of applications and utility.[77]

The performance interfaces described in this essay have been predominantly concerned with designing materials and computer instructions to aid a performer in improvisational contexts. I have not attempted to create algorithms which spontaneously compose responses to performance gesture. This approach has resonated successfully with both my identity as a composer and as an improvisor. In preparing materials such as

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76 Robert Rowe, *Interactive Music Systems* (Cambridge: MIT Press, 1993), 1.

77 Ibid., 3.

scores, sound-files, text cues etc. I am acting in a familiar mode as a composer. In programming compositional algorithms for performance I am drawing upon years of experience with computer-aided composition. The structures are left open and flexible to allow for performance freedom in improvisational contexts.

While the performance interfaces described in this essay have indeterminate processes which may create unexpected results, I view this is an issue of compositional aesthetics rather than an "interactive" feature. My intent is to keep musical expression and interaction in a human domain rather than endowing the computer with "human-like musical aptitude."

I have attempted to model the contexts of musical interaction rather than the processes of interaction. In this endeavor I am inspired by Edward Barret's approach to designing educational systems by modelling the context of learning rather than the process of learning:

> .....it makes sense to use the protean power of the computer for simulation in order to model observable phenomena in educational environments rather than programming for hypothetical mental activities whose supposed existence may dictate restrictive pedagogical practices. If we view the university as such a mechanism, then it can be defined by a specific geography, an infrastructure, an administration, groups of individuals who temporarily declare allegiances with one another, buildings, classrooms, walkways, loading zones, and of course libraries which perform a range of activities, including the preservation of hierarchies of knowledge, culture, truth, and information.[78]

He feels that learning, thought, insight, personal development and education are not things

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78 Barrett, Edward. ed. *Sociomedia* (Cambridge: MIT Press, 1994), 5.

which can be, or should be fixed by a model:

> Where is education in this metaphor? Education remains where it should be -- in the human domain of sharing ideas and information through the medium of language. Education does not sit in a black box. Education is not hardwired in. Education is not algorithmic. Since each of you reading this paragraph has a different perspective on the meaning of "education" and "learning" and on the process involved in "getting an education," think of the hubris in trying to capture education in a programmable function, in a displayable object, in a teaching machine." Education is a virtual realm: a "being in essence or effect but not in fact" (Webster), addressable, and only represented in part at any time, always a bigger conception than we can accommodate, yet because of its fullness, always enlarging whatever attempts we make to embody it in fact.[79]

Through the meta-compositional computer interface, musical scores and prose can model established modes of performance coordination, digital signal processing can model the acoustic characteristics of various performance spaces, sound-file resources can model sonic environments within which to play. In addition, the computer can extend these contexts allowing the abstraction of conventional linear scores and performance directions, "impossible" acoustic situations, the extension of instrumental techniques and characteristics, and fantastic imaginary environments to inhabit. Still, concepts such as "musical interaction," and "musical understanding" remain strictly in the human domain.

This approach also draws upon the concept of "intelligence amplification" as presented in chapter two: the resources offered performers in real -time extend their capabilities and options during performance.

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79 Ibid., 7.

Composition, Improvisation and Meta-composition

Meta-composition encompasses many different modes of interaction with technology and one finds himself in a cycle of composition, programming, performance and evaluation. These modes run parallel to those of theoretical preparation, practice, performance and listening for an improvisor, and are complimentary activities for the composer/performer.

As with improvisation, a disciplined approach to meta-composition creates a process of constant preparation and musical refinement. The progression of one's the musical life is encoded in the development of the interface, as well as in traces of recorded performances. The computer becomes an intelligent, dynamic tool for navigating the spontaneous exploration of musical space.

Appendix I

MINC Mixing Script

Here is the complete MINC script for the tape part of *Virtual Duet for Bass and Tape*. In this script , a composed ordering of 57 sound source files is drawn upon to create the final 19 minute mix. The scripts used for each mixing series were customized for that meta-composition, this example just serves to illustrate the general approach used.

```
srand(251)
openoutfile("bassnew.rt")

/* set global attributes for the mix */
  trans_factor      = 0
  trans_shift       = 0
  tracklimit      = 16
  tick              = .1

/* set acceptable ranges for section attributes */
  sectionmin        = 10
  sectionmax        = 20
  sectionrange      = sectionmax - sectionmin
  filemin     = 1
  filemax     = 2
  filerange   = filemax-filemin

/* soundfile parameters */
params  =  3
cmin  =  1
cmax  =  2

/* fill an array with references to each soundfile and the range of */
/* acceptable splice durations.                                     */
/* array format: sfname, min. chunk, max. chunk

files = load_array(0,    */ramirez/Sound/crb/bassmixes/bat.stretch",45,90,
                   */ramirez/Sound/crb/bassmixes/bat.stretch",30,45,
                   */ramirez/Sound/crb/bassmixes/bat.stretch",20,30,
                   */ramirez/Sound/crb/bassmixes/bat.stretch",10,20,
                   */ramirez/Sound/crb/bassmixes/bat.stretch",5,10,
                   */ramirez/Sound/crb/bassmixes/timemix9",5,10,
                   */ramirez/Sound/crb/bassmixes/tapstretch.mix",5,10,
                   */ramirez/Sound/crb/bassmixes/timemix6",5,10,
                   */ramirez/Sound/crb/bassmixes/bat.stretch",10,20,
```

```
"/ramirez/Sound/crb/bassmixes/bat.stretch",25,45,

"/ramirez/Sound/crb/bassmixes/droneC",18,30,
"/ramirez/Sound/crb/bassmixes/droneC",10,20,
"/ramirez/Sound/crb/bassmixes/droneC",8,10,

"/ramirez/Sound/crb/bassmixes/scratches.stretch",15,20,
"/ramirez/Sound/crb/bassmixes/bat.stretch",10,20,
"/ramirez/Sound/crb/bassmixes/bat.stretch",10,20,
"/ramirez/Sound/crb/bassmixes/scratches.stretch",15,20,

"/ramirez/Sound/crb/bassmixes/tapstretch.mix",2,4,
"/ramirez/Sound/crb/bassmixes/timemix10",3,5,
"/ramirez/Sound/crb/bassmixes/scratches.stretch",5,10,
"/ramirez/Sound/crb/bassmixes/timemix9",5,15,
"/ramirez/Sound/crb/bassmixes/timemix9",5,15,
"/ramirez/Sound/crb/bassmixes/scratches.stretch",5,10,
"/ramirez/Sound/crb/bassmixes/timemix10",3,5,
"/ramirez/Sound/crb/bassmixes/scratches.stretch",5,10,

"/ramirez/Sound/crb/bassmixes/droneC",2,5,
"/ramirez/Sound/crb/bassmixes/droneC",10,20,
"/ramirez/Sound/crb/bassmixes/dronemix",8,10,
"/ramirez/Sound/crb/bassmixes/sulC.stretch",8,10,
"/ramirez/Sound/crb/bassmixes/dronemix",5,8,
"/ramirez/Sound/crb/bassmixes/sulpont.stretch",8,10,
"/ramirez/Sound/crb/bassmixes/convolve.sulpont",5,8,
"/ramirez/Sound/crb/bassmixes/sulpont.stretch",8,10,
"/ramirez/Sound/crb/bassmixes/process1",8,10,
"/ramirez/Sound/crb/bassmixes/process2",8,10,
"/ramirez/Sound/crb/bassmixes/bat.stretch",5,10,

"/ramirez/Sound/crb/bassmixes/timemix8",2,3,
"/ramirez/Sound/crb/bassmixes/timemix7",2,4,
"/ramirez/Sound/crb/bassmixes/timemix6",2,4,
"/ramirez/Sound/crb/bassmixes/timemix5",5,10,
"/ramirez/Sound/crb/bassmixes/timemix6",5,10,
"/ramirez/Sound/crb/bassmixes/timemix7",2,4,
"/ramirez/Sound/crb/bassmixes/timemix8",2,3,
"/ramirez/Sound/crb/bassmixes/tapstretch.mix",4,8,

"/ramirez/Sound/crb/bassmixes/bat.stretch",5,10,
"/ramirez/Sound/crb/bassmixes/dronemix",5,10,
"/ramirez/Sound/crb/bassmixes/dronemix",5,10,
"/ramirez/Sound/crb/.sound2/bass/lowC",5,10,
"/ramirez/Sound/crb/bassmixes/dronemix",5,10,
"/ramirez/Sound/crb/.sound2/bass/lowC",5,10,
"/ramirez/Sound/crb/.sound2/bass/lowC",5,11,
```

```
                */ramirez/Sound/crb/.sound2/bass/lowC",5,12,
                */ramirez/Sound/crb/bassmixes/droneC",6,15,
                */ramirez/Sound/crb/.sound2/bass/lowC",12,20,
                */ramirez/Sound/crb/bassmixes/droneC",15,30,
                */ramirez/Sound/crb/bassmixes/droneC",35,55,
                */ramirez/Sound/crb/bassmixes/droneC",100,120)

/* initialization */
track         = 1
/* max array is 256? */
files               = files/3
fwhatis(files)

/* array numbers*/
order       = 1
aggregate   = 2
tracklock           = 3
transposition       = 4

for (i=0;i<tracklimit; i = i+1)put_array(tracklock,i,0)

/* set sound file order */
for (file = 0; file < files; file = file+1){
     infiles(get_array(0,file*params))
     put_array(aggregate,file,0)
     put_array(order,file,0)
     }

     /*write other rt info */
     setheader(tracklimit)


     /* choose file order positions */
     for (file = 0; file < files; file = file+1){
      /* random order */
      /*position = trunc(random()*files)
      while(get_array(aggregate,position)) position =
            trunc(random()*files)
      */

      /* composed order */
      position = file

      put_array(aggregate,position,1)
      put_array(order,file,position)
     }

     outskip  = 1
```

```
i        = 1
lastfile = 0
lapflag  = 0

 /* loop based on duration */
 /* while(outskip <= out_dur){*/
 /* loop based on set of files */

   while (lapflag < 1){

 f           = 0

 filestart   = lastfile
 file_limit  = trunc(random()*filerange+.55)+filemin
 lastfile    = filestart + file_limit
 if (lastfile >= files)  lastfile = files

 gainfactor  = random()*.5
 trans_range =  random()*trans_factor

 /* choose file transposition levels for this section */
 for (j=0; j<file_limit; j = j+1){
       transp       = trunc(rand()*(trans_range+.5))-trans_shift
       put_array(transposition,j,transp)
 }
 start             = outskip
   section         = random()*sectionrange + sectionmin
   sectioncnt      = 0

 /* set section values */
 NEWSECTION(section,filestart,lastfile)
 while (sectioncnt < section ){
      if (i >= files || lapflag==1){
          i = files-1
          lapflag = 1
      }
      if (i==lastfile+1) i = filestart
      file    = get_array(order,i)
      input(get_array(0,file*params))
      chunkmin = get_array(0,file*params+cmin)
      chunkmax = get_array(0,file*params+cmax)
      duration = random() * (chunkmax-chunkmin) + chunkmin
      if(duration < 0 || duration > dur(0)) duration = chunkmin
      inskip   = random() * (dur(0) - duration)
      gain     = random() * (.4 + gainfactor)+.2
      if (gain >1)gain =1
      attack        = random() * .2 + .1
      decay  = random() * .2 + .3
```

```
        transp   = get_array(transposition,f)
        if(file >= 10 && file <= 15) transp = 1
        if(file >= 25 && file <= 34) transp =-2
        /*if (file > 28) transp   =  0*/
        tflag = 1
        if (transp < 0) tflag = -1
        if(duration < 1) transp = tflag * (trunc(rand() * transp + .5))
        pan      = random()*.8 + .1

        /*generate playnote for rt */
        playnotes(track,file+1,outskip,inskip,duration*(-1),
                transp,gain,attack,decay,pan)

        /* lock the track until this sound is done to prevent */
                                                              */
        /* clicks
        endtime   = outskip+duration
        whatend(endtime)
        put_array(tracklock,track,endtime + .02)

        /* space maker */
              /* max = maximum outskip increment % of duration */
              /* min = minimum outskip increment %  */
              max      = .5
              min      = .25
              skiprange = duration * (max - min)
              minskip   = duration * min
              outskip       = outskip + random() * skiprange + minskip

        /* choose track */
        track = 1
        while(outskip < get_array(tracklock,track)){
              track = track+1
              if(track > tracklimit) {
                    track = 1
                    outskip = outskip + tick
              }
        }
        i = i + 1
        f = f + 1
        if (f > file_limit) f = 0
        sectioncnt = outskip - start
        }
    }
/* write the file */
setoutfile("/ramirez/temp/crb/mix")
```

Appendix II
SenseTalk Script Example

Following is an example of a SenseTalk script used in programming the interface for *Transitions*. In this script, a user designed chord progression is read and analyzed producing a second order transition table for use in generating new chord progressions in performance.

```
-- <<<<<XXXXX<<<<<XXXXX<<<<<XXXXX<<<<<
--The Script of Unique Button "analyze"
-- >>>>>XXXXX>>>>>XXXXX>>>>>XXXXX>>>>>

on mouseup
    global analysis_data
    -- initialize containers
    put 0 into count_2
    put 0 into count_3
    put empty into summary_2
    put empty into summary_3
    put empty into analysis_data

    put the number of lines in field list into count
    put  line (count-1) of field list into  current_value
    put current_value into field init_current

    put line (count -2)  of field list into last_value
    put last_value into field init_last
    --summary
    repeat with each line  of field list
        put word 1 of it into next_value
        if next_value = "" then exit repeat
        put last_value && current_value && next_value  & return after summary
        put current_value into last_value
        put next_value into current_value
    end repeat

    sort  summary
    repeat with each line of summary
        put word 1 of it into A
        put word two of it into B
        put word three of it into C
        repeat with each line of summary
            if A=word 1 of it and B = word 2 of it then
                put count_2 +1 into count_2
```

```
            if C =word 3 of it then
                put count_3 +1 into count_3
            end if
        end if
    end repeat

    put 0 into flag
    repeat with each line of summary_2
        if A = word 1 of it and B = word 2 of it   then  put 1 into flag
    end repeat
    if flag = 0 then put A && B && count_2 && return after summary_2
    put 0 into flag

    repeat with each line of summary_3
        if A = word 1 of it and B = word 2 of it and C = word 3 of it
            then put 1 into flag
    end repeat
    if flag = 0  then put A && B && C && count_3 && return after
            summary_3
    put 0 into count_2
    put 0 into count_3
end repeat

-- assemble analysis probabilities
repeat with each line of summary_3
    put word 1 of it into A
    put word 2 of it into B
    put word 3 of it into C
    put word 4 of it into hits
    repeat with each line of summary_2
        if word 1 of it = A and word 2 of it =B then
            put word three of it into total_hits
    end repeat
    put hits/total_hits into PROB
    put A && B && C && PROB && return after  analysis_data
end repeat

put analysis_data  into field anal

end mouseup
```

Appendix III
Lingo Script Example

The following example is a Lingo script used to initialize a new sound pallette during a performance of *Prelude* . Similar code proceeds each Director animation frame which used for sound file selection in *Prelude* and the Quartet improvisations.

```
on enterframe
  global path
  global theoffset
  global midi_grain
  global count
  global files_active
  global file_max

  global theVol1
  global theVol2
  global theVol3
  global theVol4
  global playing_1
  global playing_2
  global playing_3
  global playing_4
  global playing_5
  global playing_6
  global playing_7
  global playing_8
  global theLast1
  global theLast2
  --
  global newframe
  global theTexture1
  global theLeftovers1
  global theTexture2
  global theLeftovers2
  global theTexture3
  global theLeftovers3
  global theTexture4
  global theLeftovers4
  global theTexture5
  global theLeftovers5
  global theTexture6
  global theLeftovers6
  global theTexture7
  global theLeftovers7
  global theTexture8
```

```
global theLeftovers8

--SOUND ASSIGNMENTS
if (newframe = 1) then
  put "SCENE 1 - updating sounds assignments"
  --button 1
  put "glissmix.T.Vari" into theTexture1
  put "glissmix.T.Vari_files_left" into theLeftovers1

  --button 2
  put "hchords.T.Vari" into theTexture2
  put "hchords.T.Vari_files_left" into theLeftovers2

  --button 3
  put "noise_roll" into theTexture3
  put "noise_roll_files_left" into theLeftovers3

  --button 4
  put "mist" into theTexture4
  put "mist_files_left" into theLeftovers4

  --button 6
  put "glissmix" into theTexture5
  put "glissmix_files_left" into theLeftovers5

  -- button 7
  put "hchords" into theTexture6
  put "hchords_files_left" into theLeftovers6

  -- button 8
  put "long_roll" into theTexture7
  put "long_roll_files_left" into theLeftovers7

  -- button 9
  put "rolls" into theTexture8
  put "rolls_files_left" into theLeftovers8
  set the forecolor of sprite 11 to 218
  put 0 into newframe
end if

--put hmreadmidi(1,1,"nostamp")

put 1 into update_grain
put count + 1 into count


if count >= midi_grain then
  --put hmreadmidi(1,1,"nostamp") into got_midi
```

```
put hmreadmidi(1,1,"nostamp") into got_midi
--put got_midi
if (word 1 of got_midi = 192) then
  put word 2 of got_midi into thebutton
  put "button" && thebutton+1
  if thebutton = "0" then
    if files_active < file_max then
      set the forecolor of sprite 7 to 113
      updatestage
      press1()
    else if the forecolor of sprite 7 = 5 then
      set the forecolor of sprite 7 to 113
      updatestage
      press1()
    end if
  end if
  if thebutton = "1" then
    if files_active < file_max then
      set the forecolor of sprite 8 to 113
      updatestage
      press2()
    else if the forecolor of sprite 8 = 5 then
      set the forecolor of sprite 8 to 113
      updatestage
      press2()
    end if
  end if
  if thebutton = "2" then
    if files_active < file_max then
      set the forecolor of sprite 9 to 113
      updatestage
      press3()
    else if the forecolor of sprite 9 = 5 then
      set the forecolor of sprite 9 to 113
      updatestage
      press3()
    end if
  end if
  if thebutton = "3" then
    if files_active < file_max then
      set the forecolor of sprite 10 to 113
      updatestage
      press4()
    else if the forecolor of sprite 10 = 5 then
      set the forecolor of sprite 10 to 113
      updatestage
      press4()
    end if
```

```
end if
if thebutton = "4" then
  set the forecolor of sprite 11 to 113
  updatestage
  press5()
end if
if thebutton = "5" then
  if files_active < file_max then
    set the forecolor of sprite 12 to 113
    updatestage
    press6()
  else if the forecolor of sprite 12 = 5 then
    set the forecolor of sprite 12 to 113
    updatestage
    press6()
  end if
end if
if thebutton = "6" then
  if files_active < file_max then
    set the forecolor of sprite 13 to 113
    updatestage
    press7()
  else if the forecolor of sprite 13 = 5 then
    set the forecolor of sprite 13 to 113
    updatestage
    press7()
  end if
end if
if thebutton = "7" then
  if files_active < file_max then
    set the forecolor of sprite 14 to 113
    updatestage
    press8()
  else if the forecolor of sprite 14 = 5 then
    set the forecolor of sprite 14 to 113
    updatestage
    press8()
  end if
end if
if thebutton = "8" then
  if files_active < file_max then
    set the forecolor of sprite 15 to 113
    updatestage
    press9()
  else if the forecolor of sprite 15 = 5 then
    set the forecolor of sprite 15 to 113
    updatestage
    press9()
```

```
        end if
      end if
      if thebutton = "9" then
        set the forecolor of sprite 16 to 113
        updatestage
        press10()
      end if
    end if
  end if


  if (word 2 of GOT_MIDI = 118) then
    put word 3 of got_midi into theNext1
    if abs(theNext1-thelast1) > update_grain then
      smoothslider(theLast1,theNext1,1)
      put theNext1 into theLast1
    end if
  end if

  If (word 2 of GOT_MIDI = 11) then
    put word 3 of got_midi into theNext2
    if abs(theNext2-thelast2) > update_grain then
      smoothslider(theLast2,theNext2,2)
      put theNext2 into theLast2
    end if
  end if


 if playing_1 then
   if not soundbusy(1) then
     put spray(theTexture1,theLeftovers1) into choice_1
     set the volume of sound 1 to theVol2
     sound playfile 1,path & choice_1
     put choice_1
   end if
 end if

 if playing_2 then
   if not soundbusy(2) then
     put spray(theTexture2,theLeftovers2) into choice_2
     set the volume of sound 2 to theVol2
     sound playfile 2,path & choice_2
     put choice_2
   end if
 end if

 if playing_3 then
   if not soundbusy(3) then
```

```
    put spray(theTexture3,theLeftovers3) into choice_3
    set the volume of sound 3 to theVol4
    sound playfile 3,path & choice_3
    put choice_3
   end if
 end if

 if playing_4 then
   if not soundbusy(4) then
     put spray(theTexture4,theLeftovers4) into choice_4
     set the volume of sound 4 to theVol4
     sound playfile 4,path & choice_4
     put choice_4
   end if
 end if

 if playing_5 then
   if not soundbusy(5) then
     put spray(theTexture5,theLeftovers5) into choice_5
     set the volume of sound 5 to theVol1
     sound playfile 5,path & choice_5
     put choice_5
   end if
 end if

 if playing_6 then
   if not soundbusy(6) then
     put spray(theTexture6,theLeftovers6) into choice_6
     set the volume of sound 6 to theVol1
     sound playfile 6,path & choice_6
     put choice_6
   end if
 end if

 if playing_7 then
   if not soundbusy(7) then
     put spray(theTexture7,theLeftovers7) into choice_7
     set the volume of sound 7 to theVol3
     sound playfile 7,path & choice_7
     put choice_7
   end if
 end if

 if playing_8 then
   if not soundbusy(8) then
     put spray(theTexture8,theLeftovers8) into choice_8
     set the volume of sound 8 to theVol3
     sound playfile 8,path & choice_8
```

```
      put choice_8
    end if
  end if

end

--- Repeat frame indefinitely

on endframe
      go the frame
end
```

Appendices